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REPORT OF THE PROCEEDINGS

OF THE

TWENTY-FIRST ANNUAL CONVENTION

OF THE

AMERICAN RAILWAY

MASTER MECHANICS' ASSOCIATION

HELD AT

ALEXANDRIA BAY, N. Y.

JUNE 19th, 20th AND 21st, 1888.

EDITED BY
ANGUS SINCLAIR,
SECRETARY.

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AMERICAN RAILWAY
MASTER MECHANICS' ASSOCIATION.

OFFICERS FOR 1888-89.

PRESIDENT.
J. H. SETCHEL,
Dunkirk, N. Y.

FIRST VICE-PRESIDENT.
R. H. BRIGGS,
Memphis, Tenn.

SECOND VICE-PRESIDENT.
JOHN MACKENZIE,
Cleveland, O.

TREASURER.
GEO. RICHARDS,
Boston, Mass.

SECRETARY.
ANGUS SINCLAIR,
New York.

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PROCEEDINGS.

PRELIMINARY.

The Twenty-first Annual Convention of the American Railway Master Mechanics' Association was held at Alexandria Bay, N. Y., on June 19th, 20th, and 21st; President Setchel in the Chair.

President Setchel called the Convention to order at 9:30 a. m., and requested the Rev. C. P. Evans to open the proceedings with prayer, which was done.

The Rev. E. H. Kenyon delivered an address of welcome on behalf of the citizens of Alexandria Bay.

ROLL CALL.

Secretary Sinclair called the roll, and the following members were present:

NAME.	ROAD.	ADDRESS.
ALDCORN, THOMAS	West Shore	New Durham, N. J.
AMES, L. M.	Beech Creek	Jersey Shore, Pa.
BARNETT, J. DAVIS	Grand Trunk	Stratford, Ont.
BISSET, JOHN	W. W. W. C. & A.	Wilmington, N. C.
BLACK, JOHN	236 McKibben St.,	Lima, O.
BLACKALL, R. C.	D. & H. Canal Co.	Albany, N. Y.
BLACKWELL, CHAS.	Central Georgia	Savannah, Ga.
BOATMAN, F. P.	Ohio & Mississippi	Vincennes, Ind.
BOON, J. M.	West Shore	Frankfort, N. Y.
BRADLEY, S. D.	G. R. & Indiana	Grand Rapids, Mich.
BRADLEY, W. F.	K. & Ohio	Charleston, W. Va.
BRIGGS, R. H.	K. C. M. & B.	Memphis, Tenn.
BROWNELL, F. G.	B. & Lamoille	Burlington, Vt.
BRYAN, H. S.	C. B. & Northern	La Crosse, Wis.
BUCHANAN, WM.	N. Y. C. & H. R.	New York.
BUSHNELL, R. W.	B. C. R. & N.	Cedar Rapids, Iowa,
CAMPBELL, JOHN	Lehigh Valley	Delano, Pa.

NAME.	ROAD.	ADDRESS.
CHAPMAN, N. E.	333 Walnut St.,	Philadelphia, Pa.
CLARK, ISAAC W.	C. F. & Y. V.	Fayetteville, N. C.
COOKE, ALLEN	C. & E. Illinois	Danville, Ill.
CORY, C. H.	C., H. & Dayton	Lima, O.
DIVINE, J. F.	W. & Welden	Wilmington, N. C.
DICKSON, J. P.	Dickson Loco. Wks.	Scranton, Pa.
EASTMAN, A. G.		Sutton, Quebec.
EDDY, W. H.	Boston & Albany	Springfield, Mass.
ELLIOTT, HENRY		East St. Louis, Ill.
ENNIS, W. C.	N. Y. S. & Western	Wortendyke, N. J.
FENWICK, A.	G. B. W. & St. Paul	Green Bay, Wis.
FORSYTH, WM.	C., B. & Quincy	Aurora, Ill.
FOSTER, W. A.	Fall Brook Coal Co.	Corning, N. Y.
FULLER, WM.	N. Y., P. & Ohio	Cleveland, O.
GARRETT, H. D.	Pennsylvania	Philadelphia, Pa.
GATES, W. G.	Richmond & Danville	Salisbury, N. C.
GENTRY, T. W.	Richmond & Danville	Richmond, Va.
GIBBS, A. W.	Richmond & Danville	Atlanta, Ga.
GILMOUR, W. L	L. S. & M. Southern	Cleveland, O.
GORDON, H D.	P. W. & Baltimore	Wilmington, Del.
GRAHAM, CHAS.	D. L. & Western	Scranton, Pa.
GRIFFITH, FRED B.	D. L, & Western	Buffalo, N. Y.
GRIGGS, ALBERT	P. & Worcester	Providence, R. I.
HACKNEY, CLEM	Union Pacific	Omaha, Neb.
HACKNEY, GEORGE	A. T. & S. F.	Topeka, Kan.
HAGGETT, J. C.	D. & A. Valley	Dunkirk, N. Y.
HALL, J. W.	Louisville & Nash	Montgomery, Ala.
HARDING, B. R.	R. G. B. & A.	Raleigh, N. C.
HARRIS, GEORGE D.	Mobile & Ohio	Jackson, Tenn.
HASELTON, G. H.	R. W. &. O.	Oswego, N, Y.
HASSMAN, WM.	R. & Alleghany	Richmond, Va.
HENDEE, A.	Westingh'se Air B'ke	Pittsburgh, Pa.
HENNEY, JOHN	N. Y. & N. H.	New Haven, Conn.
HENTZELMAN, T. W.		St. Paul, Minn.
HEWETT, JOHN	1323 Jefferson Ave.,	St. Louis, Mo.
HICKEY, JOHN	M. L. S. & Western	Kaukauna, Wis.
HILL, JAMES W.	Peoria & Pekin Union	Peoria, Ill.
HOWSON, N. W.	Eames Brake Co.	Watertown, N. Y.
JOHANN, JACOB		Springfield, Ill,
JOHNS, C. T.	Valley	Cleveland, O.
JOUGHINS, G. R.	Erie & Huron	Chatham, Ont.
KILEY, M. R.	St. Jo & G. I.	St. Joseph, Mo.
LAUDER, J. N.	Old Colony	Boston, Mass.

NAME.	ROAD.	ADDRESS.
LEACH, H. L.	1 Rollins St.,	Boston, Mass.
LEWIS, W. H	D. L. & Western	Kingsland, N. J.
MACKENZIE, JOHN	N. Y. C. & St. L.	Cleveland, O.
MANLY, BASIL	A. & N. C.	Newberne, N. C.
M'BETH, JAMES	West Shore	Buffalo, N. Y.
M'GLENN, JAMES	Carolina Central	Laurenburg, N. C.
MEDWAY, JOHN	Fitchburg	Mechanicville, N. Y.
MICHAEL, J. B.	E. T. V. & Ga.	Knoxville, Tenn.
MILLEN, THOMAS	N. Y. City & N.	High Bridge, N. Y.
MORRELL, J. E.	C. R. I. & P.	Davenport, Iowa.
NICHOLS, EDWARD	Brooks Loco. Works.	Dunkirk, N. Y.
NOBLE, L. C.	H. & T. C.	Houston, Tex.
ORTTON, JOHN		Albany, N. Y.
PATTERSON, J. S.	C. I. St. L. & C.	Cincinnati, O.
PAXSON, L. B.	Phila. & Reading	Reading, Pa.
PECK, PETER H.	C. & W. I. & Belt	Chicago, Ill.
PITKIN, A. J.	SchenectadyLocoWks	Schenectady, N. Y.
PLAYER, JOHN	Wisconsin Central	Waukesha, Wis.
PORTER, JOSEPH S.	C. S. & Cleveland	Sandusky, O.
PURVIS, T. B.	Boston & Albany	East Albany, N. Y.
QUACKENBUSH, A. W.	Wabash & Western	Moberly, Mo.
REYNOLDS, W. W.	C. St. L. & P.	Columbus, O.
RICHARDS, GEORGE	14 Auburn St.,	Roxbury, Mass.
RICHARDSON, E.	S. & Alleghany	Shenango, Pa.
ROBERTSON, W. J.	C. Vermont	St. Albans, Vt.
SELBY, W. H.	C. & Atlantic	Huntington, Ind.
SETCHEL, J. H.		Dunkirk, N. Y.
SHAVER, D. O.	Pennsylvania	Pittsburgh, Pa.
SHORT, W. A.	O. & L. Champlain	Malone, N. Y.
SMITH, F. C.	P. D. & Evansville	Mattoon, Ill,
SPRAGUE, H. N.	Porter Loco. Works.	Pittsburgh, Pa.
STEPHENS, S. A.	R. I. Loco. Works	Providence, R. I.
STEVENS, GEORGE W.	L. S. & M. S.	Cleveland, O.
STEWART, O.	Fitchburg	Charlestown, Mass.
STONE, W. A.	L. E. & St. L.	Huntingburg, Ind.
SWANSTON, WM.	C. St. L. & P.	Indianapolis, Ind.
TANDY, H.	N. Y. O. & W.	Middletown, N. Y.
THACHER, THOMAS	D. L. & Western	Utica, N. Y.
THOMAS, C. F.	E. T. V. & Ga.	Atlanta, Ga.
THOMAS, W. H.	E. T. V. & Ga.	Knoxville, Tenn.
TINKER, S. B.	C. W. & Mich.	Wabash, Ind.
TURREFF, W. F.	C. C. C. & I.	Cleveland, O.
TWOMBLY, T. B.	C. R. I. & P.	Chicago, Ill.

NAME.	ROAD.	ADDRESS.
WAKEFIELD, S. W.	C. R. I. & P.	Keokuk, Iowa.
WALKER, C. W.	S. & Roanoke	Portsmouth, Va.
WATROUS, GEORGE C.	D. L. & N.	Ionia, Mich.
WEAVER, D. L.	1710 Fifteenth St.,	Louisville, Ky.
WEBBER, H. N.	O. R. & N. C.	The Dalles, Oregon.
WHITE, A. M.	SchenectadyLocoWks	Schenectady, N. Y.
WHITLOCK, JOSEPH	N. H. & D.	Ansonia, Conn.
WHITNEY, H. A.	Intercolonial	Moncton, N. B.
WIGHTMAN, D. A.	Pittsburgh Loco Wks	Pittsburgh, Pa.
WILLIAMS, R.	N. Y. Loco. Works	Rome, N. Y.
BARNES, D. L.	185 Dearborn St.,	Chicago, Ill.
FORNEY, M. N.	45 Broadway,	New York.
SINCLAIR, ANGUS	Morse Building,	New York.
SMITH, W. A.	185 Dearborn St.,	Chicago, Ill.

PRESIDENT'S ADDRESS.

President Setchel then delivered the following address:

Ladies and Gentlemen—Upon this pleasant 19th day of June I have the pleasure of extending to you a most cordial greeting. This is our twenty-first anniversary. To-day we are of age and may fairly be expected to take upon ourselves all the obligations of mechanical citizenship. At this annual meeting we ought to be able to consider the important questions that may come before us in such an intelligent, practical manner as to make the work of this convention such that all will acknowledge as being for the best interest of railway service.

For twenty years and more we have been considering the important mechanical problems pertaining to railway management; and our discussions and the results of our deliberations have been published and distributed to the public ; and this forms the basis of much of the technical knowledge that to-day makes it possible to operate the machinery department of railroads at less than one-third the cost of twenty years ago. But notwithstanding the fact that much has been done and very many improvements made as the direct result of the investigations of this Association, there yet remains much more to be accomplished. We have sometimes been found fault with because we have done so little in the way of adopting Association standards. A few words of explanation in regard to standards may not be amiss at this time. The Association has adopted some valuable standards which largely govern master mechanics in their practice in constructing the details of locomotives to which they apply, and it is a source of gratification that, where this has been done, in no case have more recent investigations made it necessary for the Association to reverse its action; thus showing that subjects were well considered and that there was really no good objection that could be brought against their use. It is a legitimate object of the Association to give expression to a preference for certain material or for certain methods of construction, as indicating what is regarded by the majority as the best practice; but unless standards can be adopted with the firm conviction that they are the best, the survival of the fittest, as it were, it may well be questioned whether it is not better to first perfect our mechanical knowledge by a comparison of views, by free, open discussion, than to attempt to decide questions not yet fully developed and that do not receive the full indorsement of the Convention; or to do what is still less to be commended in members, to favor and vote for a standard in Convention but fail entirely to carry it out in their practice. Take as an illustration the standard driving wheel center, one of the most useful and reasonable standards of the Association, adopted, after very careful consideration, by a unanimous vote; and yet it is a fact that locomotives are being constantly constructed with wheel centres within a quarter of an inch of these sizes. This shows how averse we are to yielding our own preconceived opinions, even in the face of the acknowledgment that the standard is a good one and ought to be maintained; and it also shows that a standard will not be adopted until a strong conviction of its importance is realized by the members.

A few months ago a leading superintendent of motive power and a member of our Association said to me: "At our next annual meeting you should go for the members on the importance of more standards in locomotive work;" and, feeling that the subject was important and one that might be profitably considered by the members, I asked him if he would not give me his views upon the subject. He said he would be glad to do so and would write me soon in regard to the matter. Some time after, meeting the gentleman again and not having received the letter, I reminded him of his promise. After a moment's hesitation he said: "I am not sure about this question of standards. I am afraid we are not far enough advanced; there is too much ahead of us that we have not yet been educated up to, to have the standards we might now adopt continue long in force." Is not this the key note to this question, and should we not adopt standards only as fast as we come to them, as fast as we become educated up to what we require? And is not this the real object of the Association? A mechanical educator, a collector through its committee of reports representing opinions that, when brought up in convention and discussed by the members, will give an indication of what may be considered the best practice in locomotive work. If these discussions were entered into by all the members, it would be almost an exact reflex of what is being done on our railways and in our shops in any one particular of locomotive construction.

Master mechanics, if isolated from all others, are apt to put a very high estimate on the production of their own genius, and are usually prolific in standards, and with little thought, and after a few experiments, will adopt a standard for almost anything, and in their enthusiasm will resolve to bring all equipment to this one ideal method of construction. The standard may be the best that can be devised for the purpose, but the chances are that when the light of investigation is turned on, the device will have few advocates, while the originator will probably use no other.

Is it not a fact that we cling to ideas that we have ourselves advanced, lest their abandonment should give the impression that we have not adopted the best, and thereby our reputation should suffer and our mechanical ability be questioned? It may do for an individual, from motives of self pride or other considerations, to adopt and adhere to an inferior standard; but what shall we say to the deliberations of this or any other Association that adopts an inferior method of construction and sticks to it, knowing it to be such? It would have, and would richly deserve, the contempt of every honest, fair-minded mechanic.

There is no needed improvement that cannot be brought to light by the concentrated efforts of American mechanics, and there is no cause for halting short of the best. But to obtain this needs constant, patient investigation. To adopt standards before the best has been reached means to put up the bars and stop investigation, and be content with such improvements as we may drift into. Standards should be adopted only after the most mature, painstaking investigation and a firm conviction that the best has been reached ; and, when adopted, every member is in duty bound to do all he can to secure their adoption.

As a rule, locomotives are very much the same in general construction, and if we would yield our individual prejudices, as in the case of wheel-centers mentioned, we would soon secure uniformity, and standards would naturally follow in locomotives for doing the same kind of work. There is no difficulty in adopting standard construction for standard work ; but there is great difficulty in adopting one standard for all work. It is quite easy to design an engine with all its parts properly proportioned to haul a train of a specified weight, say forty miles an hour, and that the best mechanics would pronounce practically perfect ; but how long would this practically perfect machine be allowed to do the work for which it was designed, and in doing which there would be left a margin of power and a margin of safety in its working parts ? Is it not the experience of all master mechanics, that it would be no longer than the time when there would be another car awaiting transportation, and another and still another is added until some part of the engine, under the strain of this added load, gives away ; then the disproportioning of parts commences ? If the crank pin breaks, the size of the pin is at once increased ; then the rods fail and they are made stronger ; next the axle is found light and the size of the driving axle is increased ; and now the driving wheel and crank pin hub, weakened by being bored out for the increased size of axle and pin, succumb to the inevitable, and about this time the conclusion is reached that the engine is too light for the service, and a new design for an engine for this hard service is in order.

The parts that failed in the old engine are made very much stronger in the new, and others that perhaps on account of being better material have stood the strain of hard work are left the same, to give out at some future time. These are some of the difficulties that stand in the way of a standard construction.

Now, it seems to me there is only one remedy for this, and that is, to design for the maximum of a specified work, and when a new work or harder service is required a new design should follow. But it will be suggested that this would multiply the classes of locomotives and would be objectionable on that account; but would it be more so than the continual alteration of parts that is going on in maintaining an overworked engine, and would it not be better that a new, properly proportioned machine should be brought into the service than that such a diversity in parts should exist in locomotives nominally of the same class? Indeed, we think if this plan of maintaining and working locomotives were generally adopted a less number would be required, and they could be run with greater profit. There is no reason why a well-designed locomotive should not do its maximum work continuously; and if it is profitable to keep one employed eight hours out of the twenty-four, it is just as much more so to keep it employed three times eight hours,—not by one man or perhaps by two; let it be as many as necessary to keep it constantly at work; for there is nothing in the make up of a locomotive that each of four or five of the same class should not be run by one man as well as any other of ten or fifteen equally good engineers. Locomotives should wear out, not *rust out*, and when this is properly understood and acted on locomotives will run six and eight thousand miles per month where they now run only three or four thousand at the most. Railroad men try to so arrange their schedule of trains as to save the service of a train crew; but it does not seem to have often occurred to them that they might be arranged so as to save the service of an eight or ten thousand dollar locomotive by keeping what they have constantly employed.

And right here we wish to say, engines should not only be constantly employed, that they may be a source of revenue to the company, but they should be employed in such a manner as to not be objectionable to the traveling and resident public. The black smoke that we often see and feel coming into dining and sleeping car windows, when the engine is drifting down a grade or coming into a station, and the dense black clouds of smoke that often deluge our depots, caused by the introduction of fuel in the fire-box while standing at stations or just before entering, and filling the eyes and faces of passengers and their friends, is an imposition on the traveling public, and a sharp commentary on present methods of running locomotives, and the lack of proper appliances for preventing that intolerable smoke nuisance. In these things, as in improved methods of construction, the Association is an educator, and is coming to be more and more so regarded by the public and by the railroads, as will be demonstrated if the members will but heed the lesson which they have abundant opportunity to learn.

The Association is a growing, prosperous organization. Our affairs have been so conducted as to insure a constant yearly increase in our membership, and while not a large excess in current funds has been on hand, yet at the close of each year we have been able to report out of debt, and a small balance on the other side. The present is no exception to the rule, for some of the most prominent superintendents of motive power and master mechanics have this year become members. But with this prosperity the year has also brought to us a reminder of the harvest that is to be. Death has claimed four of our members, C. T. Parry, W. H. Morrow, J. O. D. Lilly and Robert Curtis. I do not know that we can account for our prosperity on the theory that we generally ascribe to successful organizations, for we lack some of those essential elements. We are a voluntary association of men, with no band of union except the interest that we have in our business. We have no local habitation with surroundings that contribute to our success. One year we meet in Chicago, another in Boston, again somewhere else. We have no legal existence. True, we have a constitution, but even that is said by some very good authority to be in need of repairs ; and a standard constitution like similar associations is suggested. We verily believe that our constitution needs pruning. It is much like a tree that seems to have done well in the soil in which it has been planted, yet has some decayed branches ; and while we are not in favor of tearing the old tree up root and branch on that account, we would be in favor of chopping off the dead limbs that render the tree unsightly and for which we have no use.

In 1872 we met in the city of Boston, where we were presented with three thousand dollars which has since been known as the

Boston Fund. This with the additions that have been made from other sources, a detailed account of which has been presented each year, have been invested in four per cent government bonds, and now amounts to six thousand two hundred dollars, with twenty two dollars and thirteen cents of uninvested interest. The Association is to be congratulated that the the custodians of this fund have been master mechanics instead of bankers, or it might have been before this nearer the border than it is now ; but as it is, it is respectfully submitted for your examination. We have said that the Association had no legal existence. We can neither sue or be sued or legally own any property whatever ; and the Association should at this annual meeting authorize its incorporation under the laws of some one of the states, and make provisions to protect its interests and extend and perpetuate its usefulness. Our funds although not large are sufficient to excite the desire of cranks who have axes to grind, to have the Association take up their schemes and push them to completion. Great care should be taken to prevent the introduction of papers that have only the purpose of obtaining a seeming endorsement of the convention, and a saving of advertising fees by having them printed in our report.

For a detailed statement of the receipt and disbursement of funds, and conditions of membership, you are respectfully referred to the very full report of our secretary and treasurer. Coming from the source it does, it will not be considered a reflection on the former incumbent for me to say that our newly elected secretary deserves our hearty congratulations for the very satisfactory manner in which his duties have been performed the past year. The report came out early, and with some improved features that merit your approbation. The work during the year has been well kept up and faithfully performed, and it is to be hoped that circumstances may be such that the services of Mr. Sinclair may be continued indefinitely.

And now a few words as to the work before you. We have met here in this beautiful retreat on the St. Lawrence, where many of us have never been before. Our representation is large, our reception has been hearty and complete; and with the thousand beauties of nature with which we are surrounded, and the large delegation of ladies present, which is a sure forerunner of a good time outside of the convention duties, we ought to be in the best possible mood for doing good work during the hours we shall remain in session.

The reports are full and the subjects are unusually interesting, and in the discussions that follow reports, it is to be hoped that the utmost freedom will be used in making known the practice and opinions of each member present, in regard to the matter under consideration. For myself I invoke your hearty co-operation in assisting me to preside over your deliberations. I now declare the Convention opened for business

RECESS FOR ADMISSION OF MEMBERS.

THE PRESIDENT—It has been customary at this time to throw open the doors of the Association for the admission of new members. I will ask the Secretary to read Article IV. of the Constitution, defining who may become members.

On motion of Mr. H. N. Sprague, a recess of five minutes was taken.

ACCEPTING REPORT OF LAST CONVENTION.

THE PRESIDENT—Gentlemen: I hold in my hand the minutes of the last annual meeting. It has been our custom heretofore to approve them without reading. What is your pleasure in regard to it?

On motion of Mr. John Mackenzie, it was agreed that the minutes as printed be approved without reading.

Secretary Sinclair presented the following report:

SECRETARY'S REPORT.

When the last Annual Report was submitted, this association consisted of 250 ordinary, 14 associate and 13 honorary members, making the total membership 277. Since that time 53 new ordinary members have been added to the roll, 2 ordinary members have resigned, 2 ordinary members, 1 honorary and 1 associate member have died, and 3 ordinary members have been dropped for non-payment of dues, leaving at the present time a total of 322 members. The large increase of membership is gratifying evidence of the continued popularity of the association.

The ordinary members who died during the year were W. H. Morrow and Robert Curtis, the honorary member was Charles T. Parry and the associate member was J. O. D. Lilly.

The Annual Report has been in the hands of members during the greater portion of the year, and you ought to be able to judge on the valuable character of its contents. It is a volume of 211 pages and contains 24 engravings. Special pains were taken to dispense with the use of folding sheets for the illustrations, and all are placed within bounds of the ordinary page. Those who entertain themselves by searching for mistakes in the Annual Report will not be entirely disappointed with this volume ; but it is as free from errors as publications of the kind usually are. Twelve hundred of the Annual Report were printed and 1,185 of of them have been distributed to members and parties contributing to the printing fund or sold, leaving only 15 copies in my hands.

There are over 3,800 back reports in the hands of your secretary and they weigh boxed over two tons. As Chicago is not noted for exemption from fires, I have taken the precaution of insuring the reports for $2,000. The fourth and sixth reports are all exhausted. There is a good supply of all others except the last one.

The Printing Fund of the association has received unusually satisfactory support during the year. There have been 90 subscribers as compared with 55 last year and 49 the year previous. The subscriptions to this fund amount to $1,135, an increase of $413 over what was received last year. Most railroad companies contribute $10 and in return receive six copies of the Annual Report. Others call for a larger number of reports, and increase their contributions to correspond, while still others call for more copies and act on the assumption that $10 ought to entitle them to receive an unlimited number. The Annual Report is greatly in demand by educational establishments, and during the year, with the consent of the Advisory Committee, I have donated sets of reports to several institutions. The Annual Report contains a great deal of valuable information and instructive data regarding railroad machinery ; and the companies that subscribe to the printing fund receive a fair equivalent for their money. Copies of the reports ought to be in the hands of every officer in the mechanical department of every railroad. The seeds of knowledge sown by the volume will bring forth a bountiful harvest in increased efficiency, that is calculated to materially decrease operating expenses.

PRINTING FUND.

The following contributions were received to the printing fund:

Allegheny Valley Railroad Co.	$10 00
Ashland Coal & Iron Co.	10 00
Atchison, Topeka & Santa Fé Railroad Co.	10 00
Baltimore & Ohio Railroad Co.	10 00
Baldwin Locomotive Works	25 00
Boston & Albany Railroad Co.	10 00
Boston & Lowell Railroad Co.	10 00
Boston & Providence Railroad Co.	10 00
Brooks Locomotive Works	25 00
Buffalo, Rochester & Pittsburgh Railroad Co.	10 00
Burlington, Cedar Rapids & Northern Railway Co.	10 00
Capiapo, South America	10 00
Central Railroad & Banking Co., of Georgia	10 00
Central Iowa Railway Co.	20 00
Central Vermont Railroad Co.	10 00
Charleston & Savannah Railroad Co.	10 00
Chicago, Burlington & Northern Railroad Co.	10 00
Chicago & Eastern Illinois Railroad Co.	10 00
Chicago, Milwaukee & St. Paul Railroad Co.	10 00
Chicago, Rock Island & Pacific Railway Co.	10 00
Chicago, Santa Fé & California Railway Co.	10 00
Chicago, St. Paul, Minneapolis & Omaha Railway Co.	10 00
Cincinnati, New Orleans & Texas Pacific R'y Co.	10 00
Cincinnati, Washington & Baltimore Railroad Co.	10 00
Cleveland, Akron & Columbus Railroad Co.	10 00
Cleveland, Columbus, Cincinnati & Indianapolis R'y Co.	20 00
Colorado Midland Railroad Co.	10 00
Connecticut River Railroad Co.	10 00
Delaware & Hudson Canal Co.	10 00
Delaware, Lackawanna & Western Railroad Co.	10 00
Denver & Rio Grande Railroad Co.	10 00
Dickson Locomotive Works	25 00
Duluth, South Shore & Atlantic Railroad Co.	10 00

Fitchburg Railroad Co.	$10 00
Grand Rapids & Indiana Railroad Co.	10 00
Grand Trunk Railway Co.	10 00
Houston & Texas Central Railroad Co.	10 00
Illinois Central Railroad Co.	10 00
Kansas City, Fort Scott & Gulf Railroad Co.	10 00
Kelly Lamp Co.	10 00
Lake Erie & Western Railroad Co.	10 00
Lake Shore & Michigan Southern Railway Co.	10 00
Lehigh Valley Railroad Co.	10 00
Louisville, New Albany & Chicago Railroad Co.	10 00
Louisville & Nashville Railroad Co.	10 00
Louisville, New Orleans & Texas Railroad Co.	10 00
Maine Central Railroad Co.	10 00
Michigan Central Railroad Co.	10 00
Midvale Steel Co.	10 00
Minnesota & Northwestern Railway Co.	10 00
Missouri Pacific Railroad Co.	10 00
Nathan Manufacturing Co.	25 00
Newport News & Mississippi Valley Railway Co.	10 00
New York Central Railroad Co.	10 00
New York, Chicago & St. Louis Railroad Co.	10 00
New York, Lake Erie & Western Railroad Co.	25 00
New York, Ontario & Western Railway Co.	10 00
New York, Susquehanna & Western Railroad Co.	10 00
Niles Tool Works	10 00
Norfolk & Western Railroad Co.	10 00
Northern Pacific Railroad Co.	10 00
Ohio & Mississippi Railroad Co.	10 00
Old Colony Railroad Co.	10 00
Otis Iron & Steel Co.	25 00
Pedrick & Ayer	10 00
Pennsylvania Railroad Co.	10 00
Philadelphia & Reading	10 00
Philadelphia, Wilmington & Baltimore Railroad Co.	10 00
Pittsburgh Locomotive Works	10 00
Porter Locomotive Works	10 00
Portland Locomotive Works	25 00

Providence & Worcester Railroad Co.	10 00
Prosser & Son	25 00
Raleigh & Gaston Railroad Co.	10 00
Rhode Island Locomotive Works	10 00
Richmond & Alleghany Railroad Co.	10 00
Richmond & Danville Railroad Co.	10 00
Rogers Locomotive Works	50 00
Schenectady Locomotive Works	10 00
St. Louis, Arkansas & Texas Railroad Co.	10 00
St. Louis & San Francisco Railroad Co.	10 00
St. Paul & Duluth Railroad Co.	10 00
Southern Pacific Railroad Co.	10 00
Terre Haute & Indianapolis Railroad Co.	10 00
Toledo & Ohio Central Railroad Co.	10 00
Union Pacific Railway Co.	10 00
Western Maryland Railroad Co.	10 00
Western New York & Pennsylvania Railroad Co.	10 00
Wilmington & Weldon Railroad Co.	10 00
Wisconsin Central Line	10 00

The money receipts are:—

Printing fund	$1,135 90
Dues and initiation fees	1,130 00
Sales of reports	35 00
Total	$2,300 00

BOSTON FUND.

Principal in 4-per cent. Government bonds		$5,200 00
Uninvested interest at date of last report	$ 676 23	
Interest for current year	208 00	
Presented by St. Paul Entertainment Committee	416 90	
Total	$1,301 13	
Applied to purchase one $1,000 4-per cent. Government bond	1,279 00	
Balance, uninvested interest on hand	$ 22 13	
Total principal now held in 4-per cent. Gov. bonds		$6,200 00

Respectfully submitted,

ANGUS SINCLAIR, *Secretary.*

On motion of Mr. Sprague, the report was received.

TREASURER'S REPORT.

Secretary Sinclair read the Treasurer's Report, as follows:

Cash on hand as per last report			$ 497 22	
June 23-'87,	Rec'd of	J. H. Setchel	540 00	
July 6- "	"	" "	223 00	
" 26- "	"	John B. Cox	416 90	
June 18-'88,	"	Angus Sinclair, Sec'y	1,537 10	$3,214 21
Expenditures.				
June 23-'88,	Paid	J. H. Setchel (salary Sec.)	$1,037 22	
July 6- "	"	C. T. Brown, reporting	20 00	
" 7- "	"	J. H. Setchel (salary Sec.)	162 78	
" 28- "	"	J. H. Setchel (applied to Boston Tres.)	416 90	
June 18- "	"	Angus Sinclair (Sec. expenses.)	141 90	
" " "	"	John Morris, printing	21 08	
" " "	"	Donnelley & Sons, "	426 10	
" " "	"	G. H. Benedict, engraving	117 00	
" " "	"	C. H. Van Arsdale, ins.	8 00	
" " "	"	C. T. Brown, reporting	125 65	
" " "	"	L. S. & M. S., transport.	2 34	$2,478 97
Cash on hand June 19, 1888				$ 735 25

GEO. RICHARDS, Treas.

On motion of Mr. Sprague, the report was received.

AUDITING COMMITTEE.

THE PRESIDENT—It has been customary at this time to appoint a committee to audit the accounts of the Secretary and Treasurer. Will you have such a committee appointed?

MR. SPRAGUE—I move that that committee be appointed.

The motion was carried.

THE PRESIDENT—I will appoint on that committee J. Davis Barnett, M. N. Forney and John Player. They will take the accounts of the Secretary and Treasurer, and also make an examination of the Boston fund and report.

COMMITTEE TO COLLECT DUES.

There should also be appointed at this time a committee for the collection of dues, which is a very important matter. Will any one move the appointment of such a committee?

On motion it was agreed that such a committee be appointed.

THE PRESIDENT—I will appoint on that committee Harry Tandy, George Richards, Treasurer, and R. W. Bushnell.

The next business in order is the report of the Committee on the Relative Proportion of Cylinders and Driving Wheels to Boilers. The Committee consists of Charles Blackwell, Clem Hackney and John McGrayel. The report is in the hands of the Secretary and will be read.

Mr. Charles Blackwell read the report of this committee as follows :

REPORT ON RELATIVE PROPORTION OF CYLINDERS AND DRIVING WHEELS TO BOILERS.

Your Committee on Boiler Proportions beg to submit the following report :

The total heating surface of a boiler should be governed by the horse power developed when the engine is exerting its maximum continuous effort.

To obtain the most economical results, boilers can not be designed to suit the many various conditions of service and character of fuel by any hard and fast rule.

For average practice, with bituminous coal, when steam passages are ample, your Committee recommend that two square feet of heating surface be provided for each horse power developed, when engine is exerting its maximum continuous effort.

To arrive at such maximum horse power it is suggested that for ordinary passenger and freight engines a piston speed of 800 feet per minute in connection with 40 per cent. of boiler steam pressure be assumed ; and upon this assumption the following formulæ for engines with 24″ stroke are submitted :

A. Piston area of one cylinder in square inches $\times 5.8 =$ Total heating surface in square feet.

B. Total heating surface $\div 11 =$ Fire-box heating surface.

C. Total heating surface $\div 70 =$ Grate area.

D. Total heating surface $\div 400 =$ Flue area.

It appears that the grate area is capable of a wider range in dimensions than other parts of the boiler ; and by making this abnormally large, as in the case of the Wootten and other kindred boilers, grades of fuel, otherwise of little use, can be successfully burned.

With the same size of cylinder, a switching engine requires less heating surface than a road engine, the difference depending upon the special requirements in each case ; but the same rule may be applied—viz., to provide two feet of heating surface for each horse power developed during maximum continuous effort.

Your Committee considers that the recent progressive steps in boiler proportions, noticeable in all parts of the country, are largely due to the untiring exertions of your secretary, through the columns of his well-known paper, and information received from him, Mr. J. Davis Barnett, and Mr. D. H. Neale, have very materially assisted your Committee in the preparation of the above report, which is very respectfully submitted by

CHARLES BLACKWELL,
CLEM HACKNEY,
JOHN McGRAYEL,
} Committee.

SUPPLEMENTARY.

MR. BLACKWELL—I may state that at the last moment, just as the report was being forwarded to the Secretary, an answer to the circular was received from Messrs. Rhodes and Forsyth, of the C. B. & Q. It has been thought desirable to consider this as a supplement to the report. If you think it necessary, I will have pleasure in reading it.

THE PRESIDENT—If there is no objection, the letter will be read by Mr. Blackwell, as recommended by the committee.

Mr. Blackwell then read the following letter:

CHICAGO, BURLINGTON & QUINCY R. R. CO.,
Office Superintendent Motive Power,
Aurora, Ill., *June 7, 1888*

MR. CHARLES BLACKWELL,
Care Angus Sinclair,
Phenix Building, Chicago.

DEAR SIR: In reply to the circular of the Master Mechanics' Association on the proportions of cylinders and driving wheels to boilers, we do not follow any fixed rule, but keep within certain limits which successful practice indicates. We find that boilers of good design for bituminous coal have for their proportions the following ratios:

	MAX.	MIN.	AVERAGE.
A.—Grate to heating surface	1:45	1:70	1:60
B.—Tube area to grate	1:7	1:5	1:6
C.—Heating surface in sq. ft. to total cyl. capacity in cu. in. 3 per cent. added clearance	1:8	1:10	1:9
Taking into account the diameter of wheel, we have, with 85 per cent. boiler pressure as mean effective pressure.			
D.—The ratio of heating surface in sq ft. to tractive force—Passenger	10:1	12:1	11½
Freight	13:1	18:1	15

C., B. & Q. Pass.	*15x22*	*A*	*B*	*C*	*D*
Average as above		1:60	1:6	1:9	1:11
Fast Pass. Eng. 139	63″ W.	1:55	1:7	1:9	1:11
17x24 A	69″ W.	1:70	1:5.6	1:9	1:10
18x24 A	69″ W.	1:70	1:5.6	1:10	1:11
Class H new	68″ W.	1:61	1:5.9	1:9.26	1:11.85
Freight.					
Av. for good engines		1:45	1:8	1:9	1:15
Old class D 20x24	52″	1:46	1:8.38	1:12	1:18.6
New class D 20x24	52″	1:44.8	1:8.5	1:9.94	1:15.7
Switchers.					
Class E 16x22	52″	1:75.5	1:5.5	1:10	1:15.45
Class G 18x24	52″	1:76.7	1:4.8	1:10.78	1:16.5

GENERAL AVERAGES.

Ratios.	*Passenger.*	*Freight.*	*Shifting.*
Heating surface sq. ft. to tractive power, lbs.	1:11.5	1:15	1:16
Grate to heating surface	1:60	1:45	1:70
Tube area to grate	1:6	1:8	1:5

Taking now the first case mentioned in the circular, the tractive force, with mean effective pressure equal to 85 per cent. of boiler pressure, is 17,300 lbs. Taking from our table the ratio of heating surface to tractive power, 1:11.5, we then have,—

1st.—Passenger. $\frac{17300}{11.5} =$ 1500 sq. ft. heating surface.

$\frac{1500}{60} =$ 25 sq. ft. grate surface.

$\frac{25}{6} =$ 4.16 sq. ft. tube area.

2d.—Freight. $\frac{26200}{15} =$ 1750 sq. ft. heating surface.

$\frac{1750}{45} =$ 38.8 sq. ft. grate surface.

$\frac{38.8}{8} =$ 4.85 sq. ft. tube area.

3rd.—Shifter. $\frac{21580}{16} =$ 1350 sq. ft. heating surface.

$\frac{1350}{70} =$ 19.3 sq. ft. grate surface.

$\frac{19.3}{5} =$ 3.8 sq. ft. tube area.

In using 160 lbs. pressure instead of 140, as has been the practice, about 14 per cent. more heat is absorbed by the steam and that much more heating surface must be provided.

Yours truly,

(Signed) GODFREY W. RHODES, Supt. M. P.
WM. FORSYTH, Mech. Eng.

THE PRESIDENT—Gentlemen: You have heard the report of the committee; what is your pleasure in regard to it?

MR. SPRAGUE—I move it be received.

The motion was carried.

DISCUSSION ON REPORT OF COMMITTEE ON RELATIVE PROPORTION OF CYLINDERS AND DRIVING WHEELS TO BOILERS.

THE PRESIDENT—The report is received and is now before you for discussion. It has been customary in discussing the reports,—I think it is a very great advantage too—that the compiler of the report should lead, on some of the principle features, in order to bring out discussion. I should be glad to hear Mr. Blackwell.

MR. CHARLES BLACKWELL, Central Georgia—As regards the report on boiler proportions, your committee wishes to be distinctly understood that they do not wish to have these formulæ that are proposed, to be considered as any hard and fast rule. They wish it to be considered that these may be average quantities and average proportions which may be varied at will, either in one direction or another, to suit the various conditions of service for which the engine in question may be designed.

MR. J. DAVIS BARNETT, Grand Trunk—I was interested in the circular of this committee, and looked up what information I could get upon the subject. I was the more interested because there are some very curious anomalies about our engines and their advertised power. For instance, I will take a series of seven locomotives turned out by one of our large firms within a few weeks of one another. The printed statement in reference to these locomotives said, as it is common, that they would haul a given number of tons on a level. We all understand that statement. But anybody not understanding the situation from our own point of view, would infer that there was some proportion of the boiler on those engines to the number of tons they would have to haul. Working out the figures I found that one of these passenger engines, for each ton it was said that she could haul, had barely one square foot of heating surface. Please put it the other way—there was one square foot for a bare ton. The other passenger engine had to haul with the same surface—one square foot,—1.57 tons. That is, every foot of heating surface on that passenger engine, supposing their speeds were equal, was expected to haul 60 per cent. more of load than the other engine. Take the freight engine; the tons per foot were 1.15, 1.27; 1.27 being for a mogul and 1.15 for an ordinary freight. The other mogul was 2.17. The switcher had 2.05. We would expect under the circumstances that the switcher would have to haul more tons per foot of heating surface; but there was that vast difference in the passenger engine, the one having to develop more power by 60 per cent.; and in the case of the mogul engine, one was a ton and a quarter per foot, and the other was perhaps two tons and a quarter. These figures seem to show that there is a necessity for some formula of the kind suggested by this committee, so that we could find out that there was some relation between the tractive capacity and the boiler capacity, and I think the figure suggested—two square feet per indicated horse power—will cover the actual practice of this continent. I examined a very large number of indicator diagrams with the object of finding out what this figure was likely to be. It is always a convenience, of course, to turn power developed into horse power, rather than trying a bare series of figures, diameter and length of cylinders, and all that.

One curious anomaly I found in looking up this matter, was, that a series of reports of an engine built by a very noted firm on this continent—and the reports were widely distributed—showed that this engine developed a maximum horse power going down grade. Therefore, it shows that in the examination of such diagrams, you have got to bear very carefully in mind the ground over which the work is being done, as well as the tons hauled behind the engine, and the figures suggested by the committee are not working down grade.

THE PRESIDENT—It is to be hoped that these questions will be sharply discussed.

MR. M. N. FORNEY—I have listened with a great deal of interest to the report which has just been read. I have been led to think, however, that the subject has been made unnecessarily complicated. Now, in my own experience with locomotives, I have found that you can never get the boiler too big, and the maxim which has been started, that within the limits of weight and space, to which you are necessarily confined, you should make the boiler as big as you can get it, I think is the rule to follow. It works out this way: If you take a locomotive, say with 16,000 pounds on each wheel, which would be 64,000 on the four, half of that amount on the truck—32,000 pounds—would give a total weight of 96,000 pounds. The problem then is to build a locomotive to weigh 96,000 pounds, which will give the greatest amount of efficiency. The first thing to determine is the size of wheels required for the special service in which that engine is to be employed, then to proportion the cylinder, and I know no better rule than that given by the committee which had this subject under consideration last year—I mean the proportion of cylinder to wheel. The connecting rod and the cross heads and guides, and all other parts, should be proportioned to the size of the cylinder. That being the case, you can arrive at the weight of cylinders and working parts of the engine, and you will know what is left to put into the boiler. If I were designing an engine under those circumstances, I should make the boiler as big as possible so as not to exceed the weight which is there. I think that simple rule, if carried out, will give as good results as any other. But when you come to the matter of the relative size of the grate to that of the heating surface, then the question becomes more complicated, because the size of the grate depends on the quality of fuel that is used, and there is very much greater diversity in practice in the construction of these parts than there is in that of the heating surface; so that I think you are perfectly safe in following that general maxim that within the limits of weight and space to which you are confined, you cannot make the boiler too big nor the heating surface too great.

SECRETARY SINCLAIR.—I agree in a general way with my friend Mr. Forney, in his remarks. As a rule you can never get the boiler too large, or at least you never get it too large, and that is a very good plan which he has outlined of designing the cylinders to suit the wheels and then making the boilers as large as possible. But, unfortunately, that has not been the plan usually followed by our designers. The engineers, or those responsible for tracks and bridges, have generally said they wanted the weight on wheels to be kept down to within a certain limit. An engine has to be designed to meet that requirement, and the transportation department have always used their influence to get as large cylinders as possible. Consequently, what meets with most consideration are the cylinders; have them large enough and it doesn't matter what kind of boiler you have. Get the cylinders large enough—that is all they call out for, and every one here knows that the transportation department has a very great influence on these designs—more influence than what is wise for their own companies; and master mechanics are often induced to enlarge cylinders, against their own judgment, till they are out of proportion to the boiler. The report of the committee here gives about thirteen hundred feet of heating surface for a 17 by 24 cylinder. These proportions every one understands. Every one also understands that it is a large proportion of heating surface to the cylinder capacity; and the aim of the committee evidently is to encourage the designers to make as large heating surface as possible, and as large proportion of boilers to cylinders as possible. If this comes to be recognized as a standard with the Master Mechanic's Association, a master mechanic who is urged by his superintendent to make a large cylinder and a small boiler can say: " Here is the proportion recommended by the Master Mechanics' Association. You want to have the engine all out of proportion to that, and the machine will be expensive to operate, and I do not think we ought to get a locomotive of that kind out." Consequently I think that the adoption of that report, and the adoption of the committee's report as a standard is calculated to do good to the Association and good to the interest of the members and of railroads generally.

MR. WILLIAM FORSYTH, Chicago, Burlington & Quincy.—I have not much to add to what has been said, except to inquire into the term " heating surface " which I think, as matters stand now, is used in a very indefinite way. There is certainly a great difference between the value of tube heating surface and fire-box heating surface, and I believe that it should be the peculiar province of this Association, to determine what those values are. In addition to work on boilers, I think the best thing this Association could do would be to inaugurate some experiments to determine the relative value of tube heating surface and fire-box heating surface in locomotive boilers.

MR. JOHN HICKEY, Milwaukee, Lake Shore & Western.—Mr. Forney states that he would advocate the enlargement of the boiler without limit. I would like to inquire, whether he would advocate the enlargement at the fire box, or would he advocate the lengthening of the boiler. Would he enlarge its diameter, or would he increase its length from the present as generally constructed? I agree w th Mr. Forsyth when he says, that we ought to ascertain what are the relative values of the fire-box and tube heating surface. I think it is a matter of great importance. In designing a locomotive, if we design an engine with an enlarged cylinder, we have of course to enlarge the boiler capacity. The question is whether an increase of flue surface is necessary, or whether increasing the diameter and increasing the number of flues would accomplish the same end.

MR. FORNEY.—As Mr. Hickey has asked a question, I feel called upon to reply. The question of the relative length and diameter of boilers is usually fixed, from the fact that the length of the engine is determined. In an eight wheel American type of engine, we usually have a length from which you cannot depart without some very material modification of the plan of the engine; so that the length of the tubes is fixed, and the only thing which is left in increasing the capacity of the boiler is to increase its diameter. In mogul and ten wheel and consolidation types of engines, very much the same condition of things exists. Now, if by some different design it were possible to lengthen out the boiler, I should feel inclined to do it by lengthening the tubes and increasing their diameter somewhat. If, on the other hand, I was obliged to shorten the boiler, I should decrease the diameter of the tube and increase the outside diameter of the boiler. We are obliged to be guided by circumstances in such matters. The main point which I wish to impress and which I wish to emphasize is, that boilers are never too big; that is within the limits of weight and space to which you are confined. Mr. Sinclair has spoken of the weight on the wheels—that they are limited there by the permanent way department, which is very true. There nearly always is some limitation in that direction. Then with a 4 ft. 8½ in. gauge we have a width we cannot exceed under our fire-boxes. So that those two facts always keep the weight of the engine down to certain limits. Within those limits, I would be inclined to make the boiler just as big as possible. I would also be inclined to adopt whatever form of boiler or plan of construction for the crown sheet and those parts that would permit of an increase of size and increase of capacity. I think that matter has been overlooked. There are a great many boilers which take an enormous weight to support the crown sheets. If you could diminish that weight, it would enable you to increase the diameter or length of the boiler, which would be a material advantage; whereas the crown bars and the bars which are accumulated there, do nothing whatever to help to make steam.

I would also add that some experiments were made by Mr. D. K. Clark, many years ago, which are reported in his book on Railway Machinery, which showed that the larger the tube heating surface the greater the economy; and he put no limitation on that whatever. In all the experiments he made, he found the greater the tube surface was, the more economy he got. He also found this fact, which was, that the smaller the grate surface the greater the economy. Of course, the grate surface must be large enough to burn a sufficient amount of fuel, but the more he concentrated the fire the greater economy he got out of the combustion. I know that conclusion is questioned by a great many people, but I know that that is the conclusion he reached, and that a great many other engineers have reached.

MR. O. STEWART, Fitchburg.—I would ask if that was in wood burning or coal-burning engines?

MR. FORNEY.—Coal burning—bituminous coal; and coke, perhaps. They experimented with coke in those days a good deal.

MR. H. M. SPRAGUE, Porter Loco. Works.—I would ask Mr. Forney if the value of an increased area of flue surface would not be governed by the length. You would not enlarge the size of the flues to get an increased flue surface of a given length, beyond reason. I would like also to inquire what is the practice with flues—whether anybody is using flues much larger than two inches, within reasonable length. That is a matter that I am rather ignorant about, and it is rather difficult to get information on the subject. I do not see why, as we have apparently found that a two inch flue is long enough for ten feet six, to eleven feet and such lengths, but when we are getting up to thirteen and fourteen feet, should not a larger flue be used? But I do not understand that it is the general practice to do so, and I do not know any reason why.

MR. FORNEY.—In answer to Mr. Sprague's question I might say that the reason for enlarging the size of the flue, would be the difficulty of drawing air through a very long and very small tube. In England the common practice is to use tubes 1¾ inches outside diameter and from ten to fifteen feet long. In this country, you know, there are very few tubes of that size used. On Winans' old camel engine in which the tubes were fourteen feet in length they were 2½ inches in diameter. With a very small and a very long tube, the friction of the gases passing through becomes very great, so that the reason for enlarging the flue when you increase its length, is simply to make the draft easier.

MR. JOHN MACKENZIE, New York, Chicago & St. Louis.—I would say that our experience does not agree with what Mr. Forney says. We have engines with flues 2¼ and 2 inches in diameter and 13 feet long, and we find that the 2 inch flue gives us better satisfaction than 2¼ inch. I think there are some twenty flues less in the larger diameter than in the smaller, and our men claim that the latter engines steam better—with the same sized nozzle.

MR. J. DAVIS BARNETT, Grand Trunk.—Do I understand Mr. Mackenzie to say that the 2¼ inch tubes were put so much closer together so as to lessen the clearance between the two?

MR. MACKENZIE.—They both have ⅝ inch water space between them.

MR. BARNETT.—While I am on my feet I might supplement Mr. Forney's statement by saying that Mr. Clarke's experiments and the data, from which his formulæ and statements published in his book were obtained, were all based on coke practice—coke burning, and that the disputes in respect to his statements since have been mostly based on coal burning.

MR. HICKEY.—Speaking of the relative efficiency of fire-box and flue heating surface, we have two classes of engines of the same general dimensions, the cylinder is the same, the fire-box the same, the grate surface the same; the only exception being that one class of engines have tubes one foot shorter than the other. In doing the same work, performing the same duty precisely, the engine with the shorter tubes makes steam, as an average, freer than the engine with the longer tube, and from observations I am prepared to say that the length of the tube does not cut much of a figure in increasing the steaming efficiency of a locomotive, beyond certain limits, of course. One of those is 12 feet 3 inches long and the other 11 feet 3 inches long, the shorter tube making the steam as freely as the longer one.

SECRETARY SINCLAIR.—There is one thing in regard to the well known experiments of Clark which has not been brought out, and it applies to Mr. Forsyth's remarks. Clark insists strongly that the deductions of his experiments indicated that a great increase of fire-box surface did not promote the economical working of the engine. He held that undoubtedly a fire-box surface was more efficient for the generation of steam than the tube, but that the tubes were placed where the greater part of the heat had to be absorbed, and that attention should be directed more closely to making those proportions right than to efforts to increase the area of the fire-box unduly.

THE PRESIDENT.—Gentlemen, it is now nearly 12 o'clock and the regular order of business will be discussions on general questions that may be introduced by the members. We have now five minutes before that time.

Mr. Mackenzie.—Is the discussion closed on this subject, Mr. President? If so, I want to make a motion.

The President.—It is not closed yet. Will you close the discussion on this subject?

Mr. Sprague.—I move that the discussion be closed.

The motion was carried.

Mr. Mackenzie.—I move that we take a recess of five or ten minutes for the purpose of collecting dues and preparing questions for discussion.

The motion was carried and a recess taken,

The President called the Convention to order at 12 o'clock and announced that the regular order of business was the discussion of questions to be submitted by members.

EFFECT OF HEIGHT OF BOILER ON WEAR OF BOXES.

The Secretary read the following question:

"What effect has the height of the boiler above driving boxes on the wear of the driving boxes and truck boxes?"

The President.—The question is, as I understand it, what effect has the center of gravity of the boiler upon the driving boxes of the locomotive.

Secretary Sinclair.—Upon the lateral wear, it is explained.

The President.—It is customary, in submitting these questions, that the gentleman proposing the question shall lead in the discussion—Mr. Briggs?

Mr. R. H. Briggs, Kansas City, Memphis & Birmingham.—We have some ten-wheel engines on our line which gave considerable trouble, and I found that they wore their driving boxes and truck boxes very much, laterally. They were very prone to leave the track occasionally, and after they effected a certain amount of lateral wear they gave us no further trouble. After that, the question of a swinging center for the truck came up, as with a bald driver in front or a flange driver; and a man mentioned the fact to me, that he believed the main cause of this lateral motion was the height of the boilers over the driving boxes. Of course I have my ideas about that, but I would like to get the benefit of the ideas of the members of the Association also.

Mr. Mackenzie.—Would not Mr. Briggs give us his ideas first? We would like to hear them.

Mr. Briggs.—Well, I believe this, that if you do not go to extremes, you get less lateral wear from a high boiler. In other words, I believe that the swing, or what we would term the lateral motion, is more taken up upon the springs in a high boiler than in a low boiler. I do not believe that this lateral wear is caused by the height of the boiler.

Mr. Mackenzie.—I might relate a little experience that we have had with some mogul engines lately, with the boiler pretty high. We have had the experience Mr. Briggs speaks of, the engines leaving the track at frog-points, and we were unable to determine what the cause of it was. The superintendent of the transportation department said it was the fault of the engine and I said it was the fault of the frog. We found that they continued to go off at one particular point. After removing the pistons and running lines through the engine, we found there was nothing wrong there ; but we found that the engines had worn a great deal of lateral motion on their driving boxes, and that the more they got the less they ran off the points of the frogs. I am of the opinion that we are all putting up our engines too tight laterally. You put your engines up tight and you heat your boxes the first trip, which makes you destroy the surface of your boxes and begin cutting the hubs of the wheels, and the consequence is you get more lateral motion than you ought to have. I have talked with people using the same class of engines, and they said they had the same trouble, and their remedy was to remove the front and back pair of wheels and give them lateral motion ; and after that was done there was no further trouble. I would say that these were mogul engines, with a 15-foot 6-inch rigid base. Since we eased off the faces of the hubs, we have had no further trouble with those engines, with the exception of this one frog, which has been changed now.

MR. BLACKWELL.—Will Mr. Mackenzie state the height of the centre of gravity at the boiler, in this case, above the track ?

MR. MACKENZIE.—I do not exactly know. Perhaps Mr. Setchel can tell.

THE PRESIDENT.—I could not tell from memory. I do not know what it is. Mr. T. W. Gentry, of the Richmond & Danville, it is suggested, has some very high boilers. His experience would be very valuable to the Association. If he is present we would be glad to hear from him.

MR. SPRAGUE.—I am under the impression that Mr. Forney has investigated that subject, and I would be glad to hear from him.

MR. FORNEY.—I have never given the matter any special investigation, but I think it is very much like the boiler—that is, that the height of your boiler is beyond your control. There are general circumstances connected with the design of an engine which oblige you to put the boiler up to a certain height, and that being the case, you have got to do the best you can. I think that is about all there is to it.

THE PRESIDENT.—Is there any further discussion of this question ?

MR. SPRAGUE.—I move that it be closed.

The motion was carried.

THE PRESIDENT.—The Secretary will read the next question.

SWING TRUCKS AND POSITION OF BLIND TIRES.

Secretary Sinclair read the following question:

"What is the experience of members with swing motion and rigid trucks for ten-wheel engines, and should the front driving-wheel tires be blind or flanged tires ?"

MR. BRIGGS.—I proposed that question. I would like to hear the experience of the Association. We have some ten-wheel engines that have a flanged tire in front, and are cutting very badly. We also have some with a bald tire in front that are not cutting much. The flanged tire engines have borne a great deal of lateral motion in their truck boxes, The bald tires have not borne much lateral motion. I have heard it contended that it should be a flange tire in front, and also that there should be a bald tire in front. In my experience those with the bald tire give more satisfaction, but we have had a limited experience with ten-wheel engines. We probably will have a great many more ten-wheel engines to take care of, and I would like to get the experience of the members with reference to that.

THE PRESIDENT.—If there is any gentleman present who has had any experience in this direction, we should be pleased to hear from him. Mr. Boon, of the West Shore, has a crooked road. He ought to have trouble in that direction, if anybody has.

MR. J. N. BOON, West Shore.—I have had very little experience with ten-wheel engines. Most of my experience has been with consolidation and American style of engines, and I should prefer, I think, under a ten-wheel engine, the regular four-wheel truck, and I think I would prefer the front pair of drivers to have a flange on, but I never have had experience enough with that class of engines to give a very definite opinion on the subject.

MR. BRIGGS.—I would like to say to the members of the Convention that this question has caused considerable correspondence between the officials of our road and the Baldwin Locomotive Works, and other works in this country, besides among master mechanics, and I find a great diversity of opinion with reference to the matter, and I do not think that any of us can afford to make any mistakes in such matters as that, and your opinions gentlemen, would be valuable and of great assistance to myself and to others who are not here to discuss the matter, and while I was not requested to bring the matter before the Association, yet I know that I would be thanked very much if I could get your several views in regard to it. It seems to me that Mr. Hewett ought to know something about this, because he has had a great many of them to control and look after.

MR. JOHN HEWETT, Wabash Western.—My personal views of the merits of the subject would be that I prefer a rigid truck for a ten-wheel engine and blind drivers in front, but as to my preference for ten-wheel engines, as compared with moguls, I would not have a ten-wheel engine if I could get a mogul.

MR. JACOB JOHANN.—My observations on the point that is before the meeting, are that swing-motion trucks are unnecessary and rather detrimental to the flanges of the tire, and not only on ten-wheel engines but also on eight-wheel engines. At least that is what I have found with engines which I have had under my control, and to overcome the difficulty we just simply blocked the swing motion and made rigid trucks, and from them we had better results. The effect with a swing-motion truck is, especially if the road is crooked, that the front end of the engine is kept swinging all the time. Consequently it throws a strain and stress on the forward flanges, and will wear them. On that question that Mr. Briggs brought up first, I am of the opinion that engines are being put up entirely too rigid for their own good. I think that certain parts of the rolling machinery should have sufficient clearance so that it will go off without undue friction. That is one of the reasons why it takes so long sometimes to break in your engines and keep them from running hot, simply because they are put up too tight and too snug.

In reference to the tire on ten-wheel engines, I have had engines with forward drivers flanged and engines with forward drivers not flanged, and from the difference in their operations I am personally convinced that the forward drivers should be blind, not flanged; that practically you want to make your engine an eight-wheel engine, and allow your forward drivers to go as they please, and in that way you get much better results. That has been my practice for several years. In all engines I had with forward drivers flanged, whenever we turned them we slipped the tire off the front ones and put it on the middle wheels, and *vice versa*, and connected them in that way, When we rebuild trucks we rebuild them rigid.

In reference to the lateral motion and the engine's freedom for passing on a crooked road, it is absolutely necessary for them to have a certain amount of lateral play in their driving wheels and truck wheels also. If you do not give it to them they will take it, as Mr. Briggs remarks, and to their own disadvantage. They will cut and grind, and you will get a bad surfaced wheel. If you give it to them at the start, they will give you no trouble. I remember some years ago, on a road that I was on, we wanted to get to a certain point, and we had to put in a very sharp curve; I think the curve was probably fourteen or fifteen degrees. I was requested to get an engine ready to do that work, and when we had her ready it struck me that I had better experiment a little first, to see if I could get around that curve with that engine. I did not go down by daylight, when everybody would laugh at me, but I went at 12 o'clock at night, and I took another engine behind us, and we did not get 100 feet in that curve before the engine went right off. We took the engine right back to the shop. The next day I jacked her up and gave her more lateral play between the driving wheel hubs. I cut out the truck centre to move an inch and a half. After that the engine went right around that curve, and worked there for a year and never got off at all. That demonstrates that if your road is crooked you have got to give a little lateral play. The centre of gravity of the boiler, I do not think, has anything to do with that part of it. In fact, I have built engines with as high a centre of gravity almost as any running, but I never found that it made any difference, where the engines were put up properly. It is my opinion that for ten-wheel engines you want the forward driver blind and a rigid centre, but you do not want it too snug, and you will get better results than you will with a swinging motion or with the forward drivers flanged.

MR. BRIGGS.—There are some very strange things connected with it. We have got three Pittsburgh engines on the road that have been there two years. We have got eight ten-wheel Rogers engines, that have been there only about eight months. The Rogers engines have worn until they have got three-quarters of an inch lateral play in their truck. The Pittsburgh engines have scarcely three eighths of an inch, and the Pittsburgh has a swing-motion truck and the Rogers a rigid truck. The wear on the flanges of the Pittsburgh engine is not perceptible at all. The wear on the flanges of the Rogers is very perceptible. Now, the question is, is this advantage due to the swing-motion truck under the Pittsburgh engines or not? My opinion is that the swing-motion truck is a great factor in the retarding of lateral wear.

MR. HEWETT.—I would ask if the forward drivers have flanges in both cases?

MR. BRIGGS—They were bald in both instances.

MR. MACKENZIE.—We have got quite a number of ten-wheel freight engines which have the blind tire forward. We consider them just the same as an eight-wheel engine. They will go anywhere that an eight-wheel engine will go, and we use them in yard service, and we fail to see any wear whatever on the flanges of these engines. They have rigid trucks, and the tires wear just as well as they do on the eight-wheel engine. I would say that if the flange is on the forward wheels you want a lateral motion truck; certainly you have got to have it. You could not run a consolidation with a rigid truck, and you could not run a mogul with a rigid truck, in my opinion. The wheel base is so great in a mogul or consolidation that there must be some lateral play forward, as Mr. Johann said here. He is a great advocate of a rigid truck for engines, but he is a great advocate of a swing truck on cars. Now, if the play of the centre of his truck an inch and a half each way does not make a swinging truck, I fail to see where the point is. I would say that for a ten-wheel engine my preference would be for a blind tire forward with a rigid truck; with a mogul or consolidation, a swinging truck and the forward driver flanged.

MR. BRIGGS.—Probably Mr. Sprague can give us an idea on that subject.

MR. SPRAGUE.—My experience, I think, would not be valuable to this Association. I have had some peculiar experience with swinging trucks at the back end of the engine instead of the front. I suppose the principle is the same. I had not only to shorten the centre, but I had to put rollers on top of the frame to get them around the curves. Then they worked first-rate.

THE PRESIDENT.—Is there any further discussion on this subject?

MR. HEWETT.—I move that the discussion be closed.

The motion was carried.

METHODS OF SECURING CROWN SHEETS.

The Secretary read the following question:

"Is there any known practice that would be absolutely safe to adopt which would dispense with crown bars?" and stated that the question was proposed by Mr. W. J. Robertson, of the Central Vermont.

MR. ROBERTSON.—Of course, you are all aware of the expense that is attached to the ordinary crown bars as used in American locomotives, and more particularly when you have to renew a fire box. At this time I have several boilers in which I am renewing the fire boxes, and in taking out the old bars and getting them right and putting them back again I find that there is an enormous expense. Now, I have heard from time to time and have seen cuts of these radial stay bolts, and I think the Grand Trunk Railway are using some. Is that so, Mr. Barnett?

MR. BARNETT.—Yes.

MR. ROBERTSON.—And I find still that the practice of the builders is to use the heavy crown bar. Now, I would like the experience of members as to whether they know that these radial stay bolts used for the crown sheets of boilers are just as safe as the old fashioned crown bars.

THE PRESIDENT.—Can some gentleman who has had experience with radial stays answer the question?

MR. F. H. PECK, Chicago & Western Indiana & Belt.—I have twelve engines with radial stays and I have twelve engines without, and those twelve engines with radial stays have not been renewed for five years, and in the other we had to renew the crown bars in eighteen months, and with the radial stays the crown sheets are in much better shape and keep much cleaner.

MR. SPRAGUE.—I have not had much experience in different methods of securing crown sheets, but what experience I have had has been very favorable to radial stays. I think there is no question but what they are both cleaner and more reliable than a crown bar. Of course the engines that I am building now are mostly tank engines. I put the domes forward almost invariably, and stay the crown sheet from the outside shell, and I have seen, especially in small engines, a good many running that have been running several years, and they seem to be safe beyond any question.

MR. ROBERTSON.—I would like to ask the gentleman from the Western Indiana road, supposing he was to have orders to run an engine on his road to carry 180 to 200 pounds pressure, would he use the same method?

MR. PECK.—Yes, sir. We carry 160 pounds now.

MR. MACKENZIE.—I would say that it would depend altogether on the design of the engine, it seems to me. I believe everybody who builds a straight boiler now is putting in the radial stays; those with the wagon-top, of course, cannot use them. Mr. Twombly had a good many; he can give us some experience in that direction.

MR BOON.—If I understand the question it is, if there is any way of dispensing with the use of crown bars. In my opinion, there is, instead of using crown bars, use stay bolts, just an ordinary stay bolt. I have had nearly five years' experience with fifty engines equipped that way, and the result has been very satisfactory. I find no trouble in keeping them tight and I never found a breakage of the bolt leading from the crown sheet to the wagon top. We also find incidentally another advantage. Where the water is bad, using the same water with crown bars, the sheets give trouble in the course of time; while in cases where the crown sheet was held up by stays, we never had scale in sufficient quantities to cause a leak. On one or two occasions mud collected, but there never was enough scale to make trouble.

MR. MACKENZIE.—I move that the discussion be closed.

The motion was carried.

THE PRESIDENT.—There being no further discussion, there is an application for associate membership which I will ask the Secretary to read, this being the hour for miscellaneous business.

APPLICATION FOR ASSOCIATE MEMBERSHIP.

The Secretary read the following:

We propose the name of Mr. D. L. Barnes, of the Railway Master Mechanic, for associate membership.

G. W. STEVENS,
WILLIAM FORSYTH,
JOHN HICKEY.

THE PRESIDENT.—Gentlemen, you have heard the application. What will you do in regard to it?

A MEMBER.—I move that it be received and a committee appointed.

The motion was carried.

THE PRESIDENT.—I will appoint on that committee J. Johann, H. A. Whitney and M. N. Forney.

MR. FORNEY.—I am under the impression that it is not in order that an associate member should act on a committee of that kind. If it is in order, I think, at any rate, it is a very bad policy to put an associate member on a committee of that sort. I therefore beg to be excused.

THE PRESIDENT.—It struck me as being eminently proper: that an associate member would be a good judge of whom he would have for his associates.

MR. FORNEY.—I think it is an honor conferred upon us in being admitted here, and that we should not sit in judgment in such cases.

THE PRESIDENT.—I will put in the place of Mr. Forney, who asks to be excused, Mr. J. Davis Barnett.

RAILROAD RATES TO THE CONVENTION.

SECRETARY SINCLAIR.—Mr. President and gentlemen, before the Convention came on I understood that a good many of the members would have to pay railway fares in coming to this Convention, for their families, and I made application to the different traffic associations for reduced fare. I had consulted with Mr. Forney about what he was doing, and I followed the same course as he did in regard to the Master Car Builders. I received word that reduced fares would be granted, and I published a notice to that effect. Shortly afterwards I received word that for some reason or other the privilege would be withdrawn, and subsequently I received notice from the Chicago & Grand Trunk Railway Company that they had agreed to give these reduced fares and they meant to abide by it whether the Traffic Association agreed to it or not, and subsequently I had a general notice from the Central Traffic Association that the fares would be reduced, and I am under the impression that another notice came. But anyhow the thing was kept in such a muddle that I could not tell very well whether the privilege was granted or not. But I wish to inform the Association that I did my best under the circumstances. I tried in every way that I knew to get the reduced fares.

THE PRESIDENT.—The morning hour having expired, under the rules the next business in order is the regular reading of reports. The chairman of the committee that is to present the next report on our list is expected here on the boat which I believe has just whistled, and it is only fair that the matter should be passed until Mr. Lauder is here, especially as another member of the committtee has suggested that it be passed. If there are no objections, therefore, we will take up the third on the list which is " Extension smoke-boxes, and brick and other fire-box arches." The committee on this subject is John Hickey, W. A. Foster and E. L. Weisgerber, and the report is in the hands of the secretary.

Secretary Sinclair proceeded to read the report.

REPORT ON "EXTENSION FRONTS AND BRICK AND OTHER FIRE-BOX ARCHES."

Economy in the use of coal used for generating steam is a matter of great and growing importance. Recent estimates have shown that over 150,000,000 tons annually, all over the world, is used for making steam. A low estimate of value of this coal at place of use would be an average of $2.50 per ton. which gives us the present annual expenditure for steam the sum of $375,000,000, from which it will be seen how largely even a small per cent. of saving would add to the wealth of the world. While mechanics and manufacturers have given much consideration and care to the improvement of the steam engine, whereby they might reduce the consumption of steam for a given amount of power, but comparatively little attention has been given to securing economy in its generation. It would trouble us very much, and we should take the earliest opportunity of having it corrected, were it plain that through imperfect machinery our engines were wasteful of steam, yet strangely we remain to some extent indifferent regarding appliances necessary to extracting the full heating value of the fuel for its formation. We know scientifically that the compounds of carbon require certain quantities of air to effect perfect combustion, yet we are not particular about ascertaining what quantities are supplied, or under what conditions, and often treat the matter as though no such combination was necessary.

The following circular, embracing a series of questions bearing on the subject, and prepared by your Committee, was forwarded by your Secretary to the members of the Association.

To the members of the American Railway Master Mechanics' Association :

GENTLEMEN : The fuel consumed by locomotives, together with the expense of adjusting fire claims, caused by fire thrown from locomotive stacks, are two of the largest items of expense connected with railway operations, " Extension smoke boxes and brick and other fire-box arches " is a subject bearing directly on the above points, and it is asked as a duty of each and every member of the Association, and of all having charge of railway machinery, to assist the Committee in getting out an intelligent and reliable report by answering as clearly and fully as possible the following questions :

First Question : What kind of fuel is used on your locomotives ; hard coal, soft coal or wood ?

Second Question : What is the average amount of water evaporated per pound of coal you are using ?

Third Question : What is your average cost per locomotive mile ?

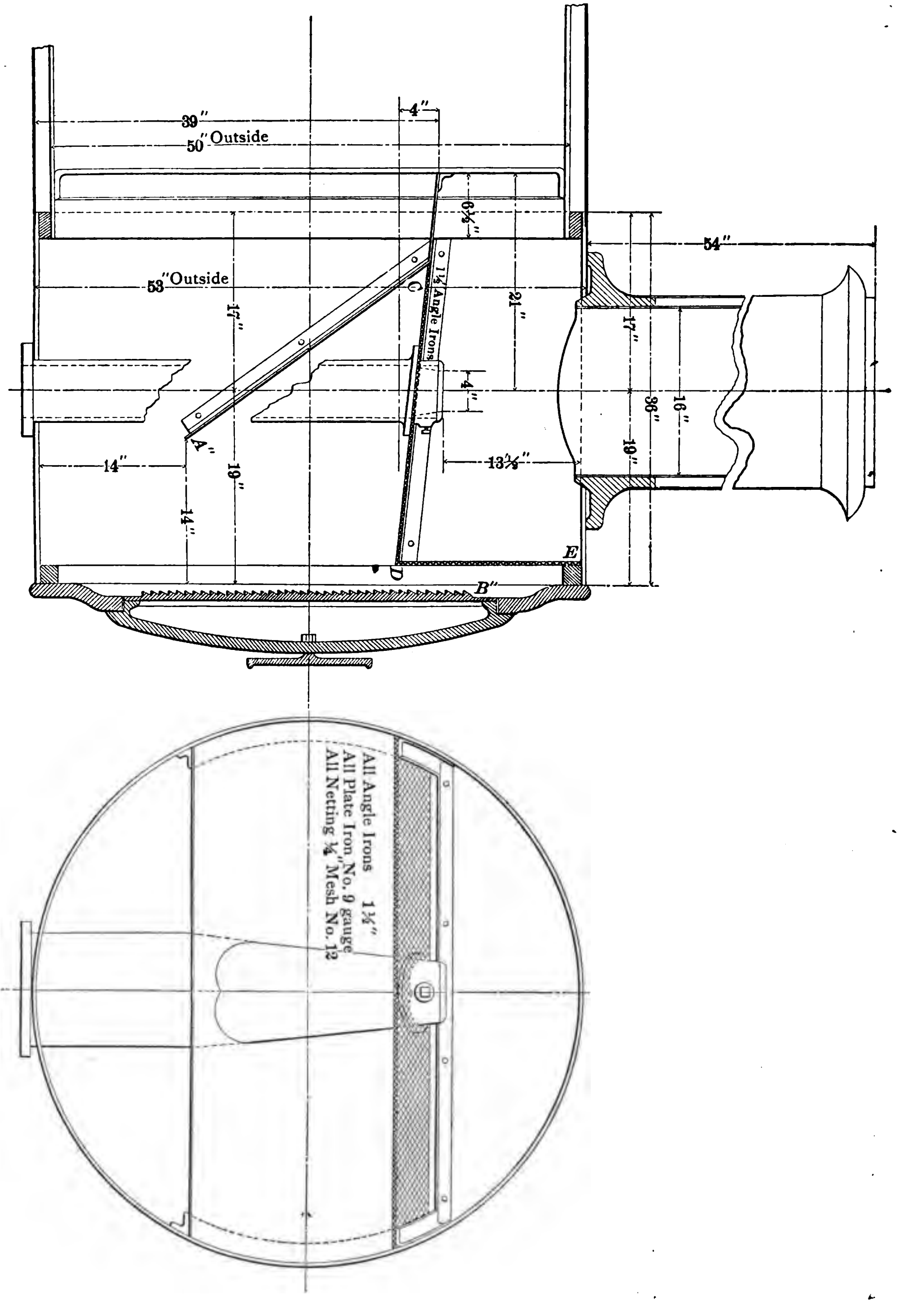
Fourth Question : What form of smoke box is used on your locomotives ?

Fifth Question : Have you had any experience with the so called " Extension Fronts?" If so, please give dimensions of the same, with sketch showing location and kind of netting, and situation of deflector plate, if any used, also situation of exhaust nozzles and arrangement for discharging sparks.

Sixth Question : What form of smoke stack do you use in connection with the extended front ? In the same connection please state size of engine cylinders, size of nozzles, demensions of fire-box, and number of flues.

Seventh Question : Do you advocate the use of single nozzle in connection with the extended front ?

Eighth Question : Have you had any experience with a device in the ordinary box that would accomplish the same end as that


39"
4"
50" Outside
6½"
54"
53" Outside
1½ Angle Irons
C
17"
21"
17"
4"
36"
16"
A"
19"
14"
13½"
19"
14"
E
D
B"
All Angle Irons 1½"
All Plate Iron No. 9 gauge
All Netting ¼" Mesh No. 12

claimed for the extended front? If so please state results obtained and send drawings of the same, and state if in connection any extras are used in fire-box as well as showing smoke-stack construction.

Ninth Question: Do you favor the use of a draft or petticoat pipe in connection with the extended front?

Tenth Question: What is the amount of additional weight caused by extended front and attachments?

Eleventh Question: How do you regard the old style smoke-box and diamond stack in economy of maintenance, economy of fuel and preventative of fires as compared with extension fronts and attachments?

Twelfth Question: Have you used a brick arch or other device in fire-box in connection with extended front? If so please give dimensions of same, with sketch showing the device and manner of sustaining it, and the results obtained as compared with the plain fire-box in the same connection.

Thirteenth Question: Do you favor the use of brick or other arch in the fire-box of a locomotive using bituminous coal, and can you say from experience that the advantage gained thereby will warrant the expense of maintaining such arch?

Fourteenth Question: Have you noticed any injuries, to fire-box sheets resulting from the use of fire-box arch? Please send drawing of the grates used in connection with your extended front.

Fifteenth Question: Under what circumstances, if any, do you advocate the use of hollow stay-bolts in fire-box for the purpose of admitting air above the fire?

Sixteenth Question: All things considered, do you favor extended fronts on locomotives as now generally constructed. If not, please state objections?

Please do not confine yourself to the questions asked, but with your advice and aid of drawings give the Committee any information you may possess bearing on the subject.

To this circular the Committee received fifteen replies, and, although the information elicited was less than your Committee had reason to expect, it was obtained from Master Mechanics in all sections of the country where bituminous coal is used for locomotive fuel, and may be accepted as representing fairly the experience of members with soft coal of different characters produced and used throughout the country.

In reply to the circular, Mr. Clem Hackney, of the Union Pacific, states he uses soft coal from the mines of Iowa, Kansas, and Wyoming, having an evaporative power of from four to eight pounds of water per pound of coal, and costing per locomotive mile run 9.4 cents.

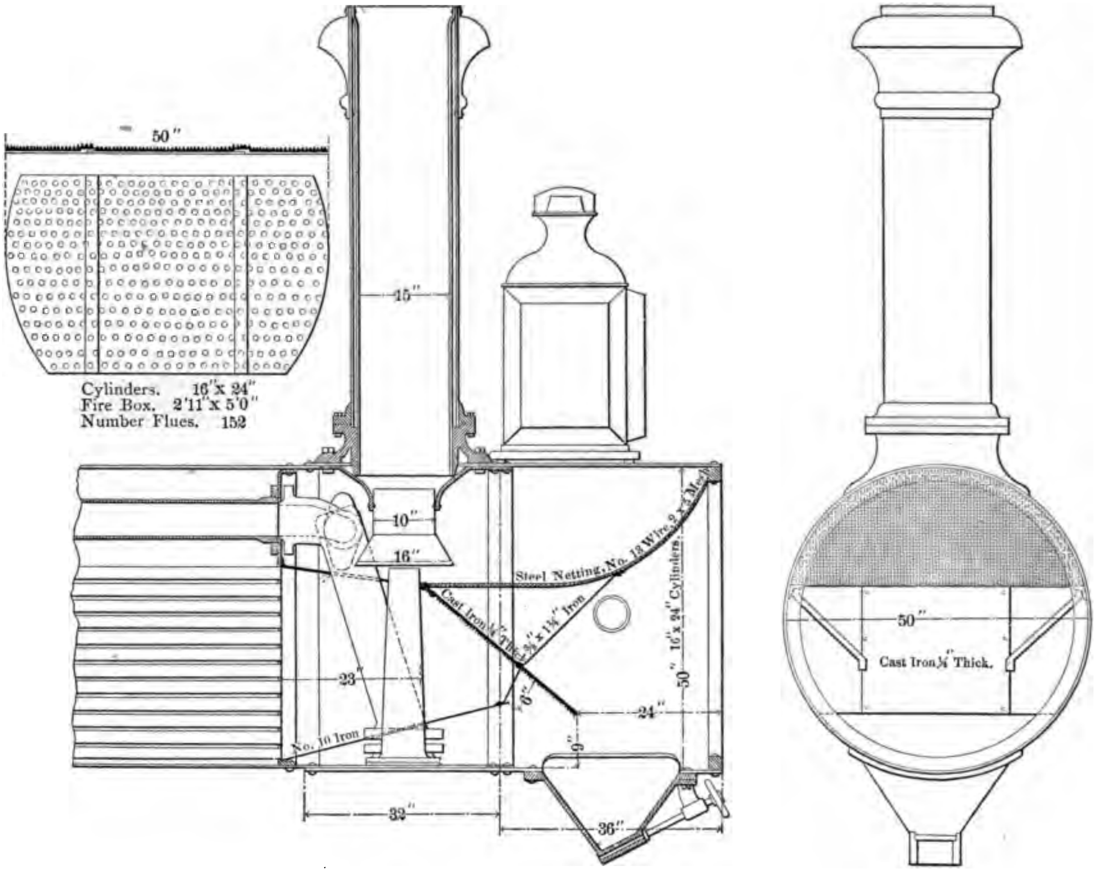
He has had a large experience with extension fronts and brick arches in fire-boxes, and, while he regards the latter as very beneficial for coal of a light nature, he does not advocate its use for bituminous coal of a heavy quality. He generally uses a straight stack with extension fronts, but has a few engines running with diamond stacks in connection with the extension, giving good satisfaction. He sends a blue print showing front end with diamond stack, which he finds preferable to any extension front.

Mr. Hackney does not indorse the use of hollow stay bolts for the purpose of admitting air above the fire, except when the coal used contains much incombustible matter, or when a heavy fire must be carried.

Mr. Robertson, of the Central Vermont Railway, uses soft coal, capable of evaporating 2½ pounds to 5½ pounds of water to the pound of coal, and costing on an average of 10½ cents per locomotive mile run.

He does not favor extension fronts on locomotives, and says they are more expensive to maintain, with no apparent gain as a preventative of fires or economy of fuel. In answer to question five of the circular, "Have you had any experience with the so-called extension fronts? If so, please give dimensions of the same, with sketch showing location and kind of netting, and situation of deflector plate if any used; also situation of exhaust nozzles and arrangement for discharging sparks," he sends a blue print (shown Figure 1), showing a front end, and writes: "I have twenty engines running with this device with cylinders from 15 by 22 inches to moguls 19 by 26 inches, and all are working very satisfactorily, both as to economy of fuel and riding of engine. In addition to this I am enabled to use a larger exhaust nozzle than with the extension front, as I do not have to exhaust the large amount of dead air contained in the extended arch, hence the blast is decreased on the fire, and less sparks are drawn through the tubes." He has obtained very satisfactory results from the use of the brick arch in the furnace, and assigns as a reason that the gases, having further to travel before reaching the tubes, come in contact with the hot brick, and mixing with oxygen from the fire hole promotes more perfect combustion.

Mr. Teal, of the Fremont, Elkhorn & Missouri Valley Railway, reports using soft coal, but never made any experiments to obtain its evaporative qualities. It costs his road per locomotive mile for fuel 8.82 cents. Mr. Teal writes: "There has been a great deal said and done about the extension front and straight stacks on locomotives. It has its friends as well as its enemies; we belong to the former. We believe in the extension as we have it, and inclose herewith a blue print of our style (shown Figure 2). Note especially the baffle plate, which you will see has cast on face side a great many sharp projections placed about one inch apart, and one and one quarter inches long, five-eighths of an inch square at base, and tapering to a sharp point. These projections are put on irregularly so as to break joints, the object being to pulverize the particles of fuel that may pass through the flues, and thus in their reduced form enable them to pass through the netting, reducing the danger of setting fires and preventing a gathering of cinder in front end. You will also notice a lower plate running forward from flue sheet to within a distance of six inches of baffle plate, its front edge being about four inches above the latter. The object of this plate is to direct the cinders coming through the lower tubes against the projections on the baffle plate. You will also see that our netting runs from front end back to front side of nozzles, where it unites with a plate of No. 12 iron, which is continued to flue sheet, where it is fastened. This plate must be well fitted to sides of smoke-box and around steam pipes, the chief aim being that all cinders coming through the flues shall come in contact with the baffle plate projections. The burning of the fire can be changed by the raising and lowering of the petticoat pipe. The device as shown burns less fuel for a given amount of work than any other we know of." Mr. Teal derives


50"
Cylinders. 16" x 24"
Fire Box. 2'11" x 5'0"
Number Flues. 152
15"
10"
16"
23"
No. 10 Iron
Steel Netting, No. 12 Wire, 2 x 2 Mesh
Cast Iron ¼" Thick
¾" x 1¼" Iron
6"
9"
24"
50" 16" x 24" Cylinders
32"
36"
50"
Cast Iron ¼" Thick.

no benefit from the use of the brick arch, and can see no advantage in using hollow stay bolts for admitting air above the fire.

Mr. Jacob Johann, of the Texas Pacific, uses for locomotive fuel ordinary soft coal, but has made no tests as to its heating qualities. The cost per locomotive mile for fuel is 12.29 cts. He is using the extended type as ordinarily constructed, and the old style smoke-box and diamond stack, but is replacing the latter with extensions and straight stacks, as fast as he can possibly do so, as he regards the cost of maintaining to be much less than the old style, and as a safeguard against fire, is far superior. He says: "As regards the enormous saving in fuel that is claimed for the extension fronts I have only to say that I consider such statements to be much overdrawn, and that when a road is fully equipped with extension fronts the fuel bills will be found to amount to about the same as they were when the road in question used the old style smoke-box, with the same number of engines and business. He has experimented with a number of devices designed to obtain the same results with common arch and diamond stack as is obtained from extension fronts, but has not succeeded in any measure in doing so. He does not favor the use of brick arch in furnace, as its advantages are more than offset by the expense of maintaining it, the principal source of expense being due to the injuries of fire-box sheets resulting from the use of it. He has proved by actual experiments that hollow stay-bolts used for the purpose of admitting air above the fire under any circumstances is detrimental, and has always found that sufficient air can be admitted through the grate bars for proper combustion, provided the firing is done properly and concludes with the following: "Taking all things into consideration, I will say that I favor the present general construction of extension fronts, as being more economical in maintenance and as better security against fire."

Mr. T. W. Gentry, of the Richmond & Danville railway, uses soft coal for locomotive fuel having an evaporative power of six and one-half pounds of water per pound, costing 9.30 cents per mile for fuel on locomotives in freight service of the consolidation type. He has had over five years experience with extension fronts on locomotives, and uses them now almost exclusively. In answer to question No. 11 of the circular Mr. Gentry writes: "I do not think the old style smoke-box and diamond stack begins to compare with the extended front and straight stack in point of economy of maintenance, economy of fuel, or preventative of fires. We have no cones, nettings or stacks to cut out, for so seldom does a netting want renewing that they frequently last several years in constant service, while, with the very best constructed diamond stacks, we have to frequently renew the cones, netting and stack linings, and often the stacks themselves; and while the extended front properly built can be made almost absolutely fire tight, as far as danger of live coals are concerned, we will all admit that it is almost impossible to prevent fire being thrown from the diamond stacks as ordinarily built." Mr. Gentry reports using the brick arch in the furnace, held in place by circulation pipes made of extra heavy hydraulic tubing, formed on a curved angle from flue sheet to crown, and finds great economy of fuel results from its use. He considers the single nozzle properly proportioned, with suitable division plate run up proper distance, a better and more economical exhaust exit than the double nozzle. He has experimented with a device for using a straight stack on short smoke-boxes with netting arrester and deflector plates, but finds it not practical. His experience has shown that very little, if any good, is accomplished by hollow stay-bolts above fire line, and does not advocate the use of such for the admission of air.

Mr. Swanston, of the Chicago, St. Louis & Pittsburgh, uses soft coal from widely different localities, and by tests finds the Pittsburgh coal to evaporate 7.35 lbs. of water, while the coal from the mines of Ohio, West Virginia, Indiana and Kentucky have an average evaporative power of only 6.30 lbs. of water to the pound of coal. His average cost per locomotive mile for fuel is 6.5 cents. He uses the extended fronts as ordinarily constructed, together with straight stacks, and is getting very satisfactory results. The cost of maintaining he says is much less as compared with the old style arch and diamond stack, and while there is but little difference in economy of fuel, he finds the device a safeguard against setting fires on the line, and concludes by saying: "In this alone it has saved many times its cost." He finds the brick arch very useful in connection with the extension, and is satisfied from experience that its advantages will warrant the use of it. The additional weight on engine truck caused by extension front and appliances Mr. Swanston finds to be about 1,200 lbs. He writes: "I know of no device that will give the same results as the extension fronts. I have tried the same general arrangement of the smoke-box with short box, and we have an extension front which was recommended as answering the purpose, but we failed to get the results."

Mr. Frank C. Smith, of the Peoria, Decatur and Evansville Ry. writes: "We use soft coal costing us about 3 cents per locomotive mile for fuel. We have locomotives in service some of which are equipped with the old style smoke arch and diamond stack, and others with extensions. In connection with the latter, we use a stack fashioned after the ejector principle. On a 17 x 24 eight-wheel engine having 160 2-in. flues, fire-box 66 x 33 in., exhaust nozzles 4¾ in. diameter, stack has opening in arch of 22 in. contracted to 13 in. at a point 17 in. above base, then opening to 15 in. at the top." In answer to question No. 8 of the circular, viz.: "Have you had any experience with a device in the ordinary box that would accomplish the same end as that claimed for the extended front? If so, please state results obtained, and send drawings of the same, and state if in connection any extras are used in fire-box, as well as showing smoke stack construction." Mr. Smith says, "Yes, had experience; was obliged to open front door every trip for the purpose of cleaning the smoke-box of cinders. The engine also sparked very badly and the results generally were so poor we had to abandon it. The construction was deflector plate, netting, high nozzle, and straight shot stack, arranged in ordinary smoke arch as in extension." He uses a fire brick arch in furnace having the slabs of brick 8 in. thick supported on arch pipe opening into tube and crown sheets. In placing the brick arch, he leaves a space about 3 in. between that and the side sheets, and a distance of 6 in. between brick and tube sheet. With the addition of an arch in fire-box he finds a saving of 21 per cent. in fuel when used in connection with the extension front. He finds not the slightest injury to fire-box sheets from the use of the brick arch, on the contrary have not so many leaky flues with it as without. He is prepared to advocate the use of

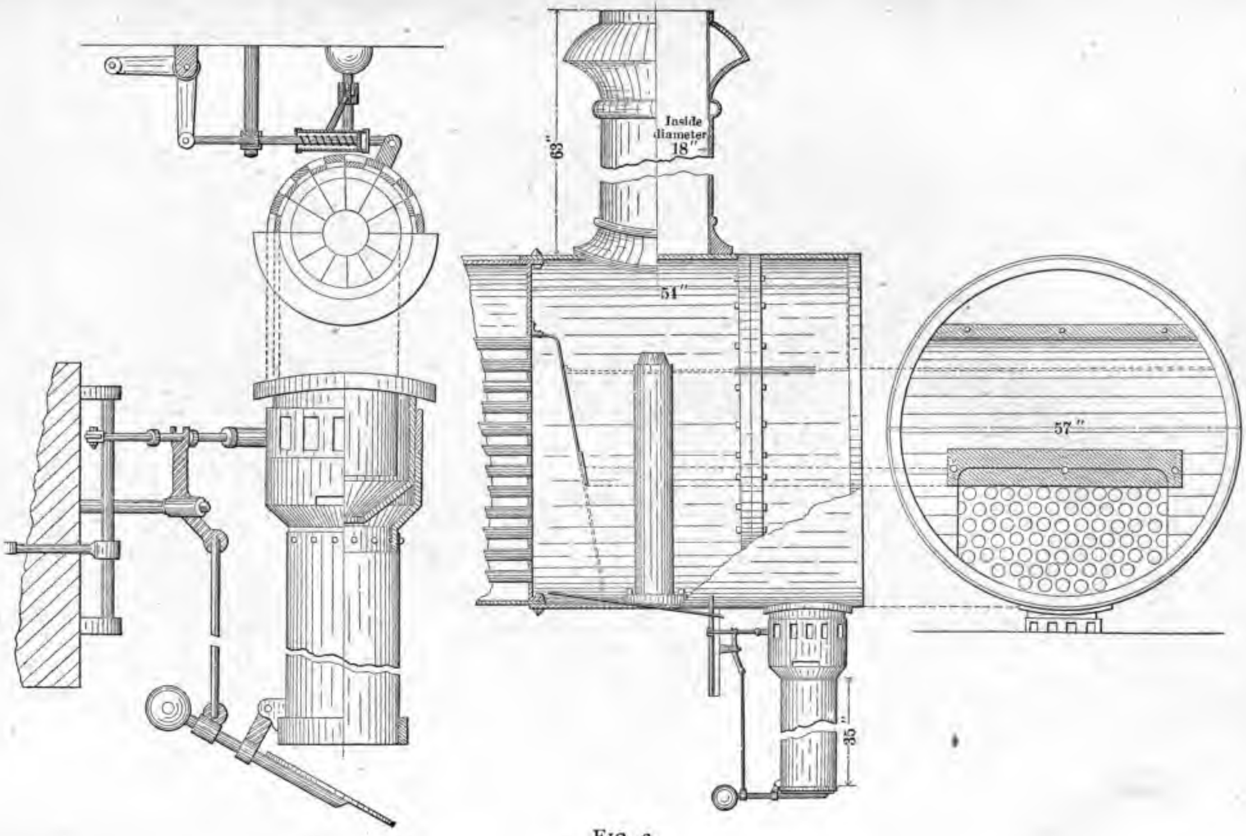


FIG. 3.

hollow stay bolts only on engines having a large amount of steam generating power in comparison with the service to be performed, and concludes by saying that the comparative merits of the old style smoke box and diamond stack, and improved extension fronts and appliances, is as stage coaching to modern railroading, as a means of transportation.

Mr. James Meehan, of the Cincinnati, New Orleans & Texas Pacific Railway, uses soft coal having an evaporative power of 7½ lbs. of water to the pound of coal, and getting an average cost per locomotive mile for fuel of 5.88 cents. He has adopted as a standard the extension fronts and straight stacks for his locomotives in connection with the fire-brick arch, and considers the whole as one of the greatest locomotive improvements.

In answer to question No. 11 of the circular, Mr. Meehan states "With the brick arch in fire-box in connection with extension fronts, a saving of 30 per cent. in fuel and 75 per cent in throwing sparks is made."

Mr. W. A. Foster, of the Falls Brook Coal Co. writes : " I send you herewith blue print (shown Figure 3) of our standard front ends, and draft regulator contrary to usual experience. In front end you will observe there is a permanent opening and an adjustable opening in the lower part of the front. Surprising as this statement may seem I have consolidated engines running burning semi-bituminous coal screenings, which we have no sale for, using the draft regulator with twelve adjustable openings 1½ in. by 3 in. and 3½ in. round permanent openings, making 63 sq. in. of opening near bottom of arch. The locomotive with all this opening makes steam very freely, and the harder she is worked the more air admission she will stand. Fire-box of this engine is 104 in. long, 58 in. deep and 42 in. wide, has 233 2-in. tubes 12 ft. 10 in. long and using two exhaust nozzles 3½ in. diameter. With coarse coal she would no doubt run larger nozzles, as it takes stronger draft to burn fine coal. The advantage of the regulator is, it softens the draft so that there is not so much cinders drawn through the tubes, making a saving in coal and throwing much less cinder from smoke stack. I have had considerable experience with the brick arch," he says, "and consider it a great advantage; locomotives equipped with this do not throw out the amount of dirt and cinders from the stack, and do not have to be handled as carefully as when running without the arch. The coal will also lie on a grate and burn more evenly and consume less, especially if it is of light quality. I am not prepared to say what the saving is, as I have never made any tests, but am convinced in a general way that it is considerable. On locomotives with long fire-boxes, I do not consider the fire-brick arch necessary. My experience has been with fire-boxes 72 in. long, that the brick arch is a decided advantage, but with boxes 96 in. to 120 in. long, I do not consider the brick arch to be an improvement."

Mr. McGrayel, of the Chicago, Rock Island & Pacific, writes, that three years ago he fitted up three engines with extension fronts and straight stacks. After getting appliance in front end properly adjusted, he had no further trouble, and engines are working satisfactorily. He says: "I cannot say there is a great amount of economy in fuel, but can say there is a saving in stacks, cones and nettings. The bottom of the smoke-box does not eat away as with the short smoke-box. The netting we use in these fronts is 3½ by 3½ mesh. None of these engines have been reported as setting fires since the extension fronts were put on, and trainmen claim they run a cleaner train." Mr. McGrayel favors the double nozzle. His extension smoke-box is 60 in. long over all and the additional weight is about 750 lbs He reports using brick arch in the fire-box, but it has proved to be of no advantage, and thinks there is no economy in its use.

Mr. Ettenger, of the Newport News & Mississippi Valley Railway, uses bituminous coal and evaporates 9.6 lbs. of water per pound of coal. His cost per locomotive mile for fuel is about 2.85 cents. In answer to question No. 11 of the circular, Mr. Ettinger says: "Old style smoke-box more economical in maintenance. With new style smoke-box no difference in fuel economy is observed, as the saving in this line is the result of the fire arch, and I would consider one style of front as economical as the other when used without furnace arch. As a preventive of fires the extended front is the most successful device of which I have any knowledge." He invariably uses the brick arch in fire-box in connection with the extended front, and declares the expense of constructing and maintaining it to be small in importance compared with the saving arising from the use of it.

Mr. Twombly, of the Chicago, Rock Island & Pacific Railway, uses bituminous coal. Has made no recent test as to its heating qualities. Cost nearly six cents per locomotive mile for fuel. He had one engine equipped with an extension front patented by Taylor of the Old Colony road. This was operated for about eighteen months, but showing no especial merit, he had the inside arrangement changed and put on a straight stack. In this form it was an ordinary extension front, long single nozzle and deflector plate, etc., but had no netting. This arrangement he found to work well enough, but showed no decided advantage over the diamond stack and old style front. Speaking further, Mr. Twombly says: "The extension as at present constructed I consider unnecessarily large, as but a small part of it fills with cinders and the upper two-thirds seems to be merely waste room. As we wash out the boilers through plug holes in front flue sheet, the extension, with its deflector plate, netting, high nozzles, etc., would be a source of great annoyance in the round house. The additional weight of the extension is just where it should not be, viz., on the truck; and lastly, I do not understand that roads equipped with locomotives having extensions are more free from fires than are other roads." Speaking of fire-box arches, Mr. Twombly states: " Many years ago I carefully observed the performance of a number of different engines, part of them equipped with brick arches, and I can safely say that any difference in economy caused by a brick arch was not perceptible. I am strongly of the opinion that with our Western coal a brick arch does not pay for its first cost and maintenance."

Mr. Geo. W. Stevens, of the Lake Shore & Michigan Southern Railway, says the fuel used on his locomotives is bituminous coal from mines in Ohio, Indiana and Illinois, and gives an average of about seven pounds of water to the pound of coal for all classes of service, and costs on an average of 4¼ cents per locomotive mile for fuel. The smoke-boxes on nearly all his locomotives are the old style with diamond stacks. His experience with the extension front is rather limited, only two of his engines being so equipped, those being used in passenger service. As to comparative econ-

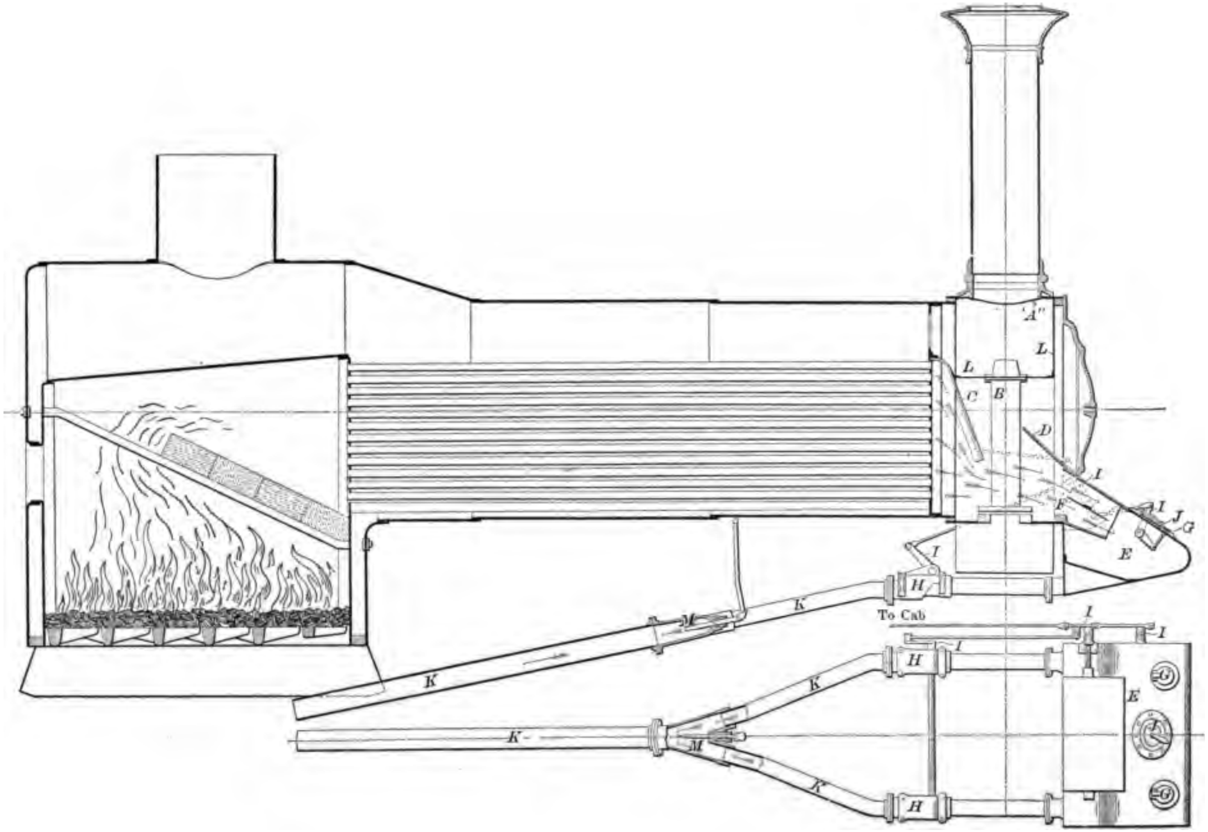


FIG. 4.

omy of maintenance of extended front and straight stack he is unable to say, but states from such information he is able to get from others who have had the extension long in use, he judges the old style with diamond stack is much more expensive. His record shows the cost of keeping in repair the old style diamond stacks, cones and nettings, etc., to be fifty cents per 1,000 miles run. He uses the fire-brick arch on all passenger engines, and he finds a saving in fuel of from 5 to 15 per cent. thereby. It is his practice to use a double row of hollow stay bolts in fire-box for the purpose of admitting air above the fire.

Mr. Roberts, of the Ashland Coal and Iron Co., of Ashland, Ky., uses bituminous coal as fuel for locomotives. He has been using extension fronts of ordinary dimensions for five years, and has no trouble or expense of any character in maintaining them. This gentleman uses a deflector plate unlike many of the others, it is fastened to top of tube sheet in the usual way, but is carried from the latter at an angle of about fifty degrees. The lower edge of plate is at a distance of 19¾ inches from tube sheet, and is 10½ inches from bottom of smoke arch. You will please note, he writes: "The front end is lined with rings of asbestos mortar, and this in turn is covered with sheet iron divided into sections that can pass easily through the door. We find this a good protection to the sheets, as they remain cooler than ordinary fronts, and if by defective workmanship or otherwise cause a leak, the cement fills them up and makes a front practically air-tight." He uses a circular door 26 inches in diameter fastened to front end with eight bolts, and is not troubled with leaky doors and has never had a hot front. He uses a brick arch in the furnace placed on angles fastened to side sheets, and considers it a great advantage both as to steaming and preventing smoke-box filling up with cinder.

Mr. Wm. Wilson, of the Chicago & Alton Railway, uses bituminous coal for fuel on his locomotives, having an evaporative capacity of five pounds of water per pound, and cost 4.91 cents per locomotive mile. Many of his locomotives are yet equipped with the ordinary smoke-box and diamond stack, others are supplied with the extension front and attachments, while a number have the ordinary smoke arch, with a new device for arresting sparks, cinders, etc. They have in use brick arches in all standard engines, forty inches long, composed of four brick, each ten inches wide. Mr. Wilson favors the use of a brick arch in the furnace of a locomotive, and is of the opinion that it will much more than compensate for the expense of maintaining. He is not prepared to say what percentage of saving in fuel is due to the use of the arch, but ventures to say it is considerable, and this, taken with the reduced amount of black smoke emitted, entitles it to considerable importance. He does not advocate the use of hollow stay bolts above the fire, as, from his experience, they serve no useful purpose. He favors the use of single nozzle, and from experience is prepared to say that it is much more desirable than the double. In answer to question No. 8 of the circular he states: "Yes, we are now equipping engines with a new and patented device which has all the advantages of the extension with none of its objectionable features. It is simple, cheap and effective, preventing any danger from fire, and is an improvement to the steaming qualities of engine over either the extension or the ordinary smoke arch." Mr. Wilson sends a blue print of the device here spoken of and ends by asserting that it is the greatest improvement over anything of the kind ever yet used on a locomotive. (Shown Figure 4.)

With bituminous coal from the mines of Ohio and Illinois having an average evaporative capacity of about six pounds of water to the pound of coal and containing 80 per cent. of combustible matter, one member of your Committee conducted a few crude and hasty experiments with an extended smoke-box and appliances in connection with a fire-box arch constructed as shown in Figure 5. The shape of smoke stack there shown was reached after a series of experiments. Starting with a stack having a straight bore in diameter equal to that of the engine cylinder, while the whole proved to be a good spark arrester was not a free steamer. Enlarging the brick arch in the furnace, permitting a small quantity of air to enter at the fire door, and adding a deflector plate over the furnace door inside the fire-box, while it resulted in doing away nearly altogether with black smoke, made but little if any improvement in her steaming or coal consumption. Leaving the situation as stated, we placed a ring about three inches deep on the inside of the stack at a point near its base, thus reducing its bore at that point from 16 inches to 14 inches; with this the steaming was much improved, and for equal work showed slightly less coal consumption. Up to this, experiments were conducted with double nozzles and short petticoat pipe. With no other change we then tried a single nozzle, and slightly bettered results were obtained. We then enlarged the stack at the top, commencing the taper at or near the ring spoken of; with this change the stack was 14 inches diameter at a point a few inches above the base and 18 inches at the top. This form showed a marked improvement in her steaming qualities, so much so, that the engineer said she could not be bettered. Finding a reduced stack diameter an improvement however, we continued the experiments and made a stack similar to that shown in the drawing, except that the contracted part was 13½ inches in diameter. With this form the engine steamed very freely and burned an even bright fire, the apparent result of an improved smoke-box vacuum.

Increasing the diameter of the nozzle one-quarter inch, and a further decrease in the neck of the stack to 13 in., proved by further experiments to be the best diameter of stack for engines having cylinders 17x24 in. while engines 16x24, did best with a diameter at neck of stack of 12 in. With this form of smoke-box, stack and fire-box arch, as shown, 4¼ in to 4½ in. single nozzles were used for locomotives of 17 in. cylinders, and nozzles 3¾ in. to 4 in. for 16 in. cylinders. In all cases the smoke-box should be perfectly air-tight, and the deflector plate adjusted to suit circumstances; as lowering and raising the latter has much influence on the fire. The small petticoat pipe shown was found to be some improvement with the double nozzle, but when using the single nozzle its effect was hardly apparent. The brick arch in the furnace we found by experiment to be a great improvement in promoting more perfect combustion and increasing the heating quality of the coal from 5.8 lbs. of water per pound of coal as tested without the arch to an evaporation of 6.3 lbs. of water with the arch in use.

The average rate of combustion during the experiments was 166 lbs. of coal per sq. ft. of grate surface per hour.

The locomotive is an eight wheel of the ordinary American

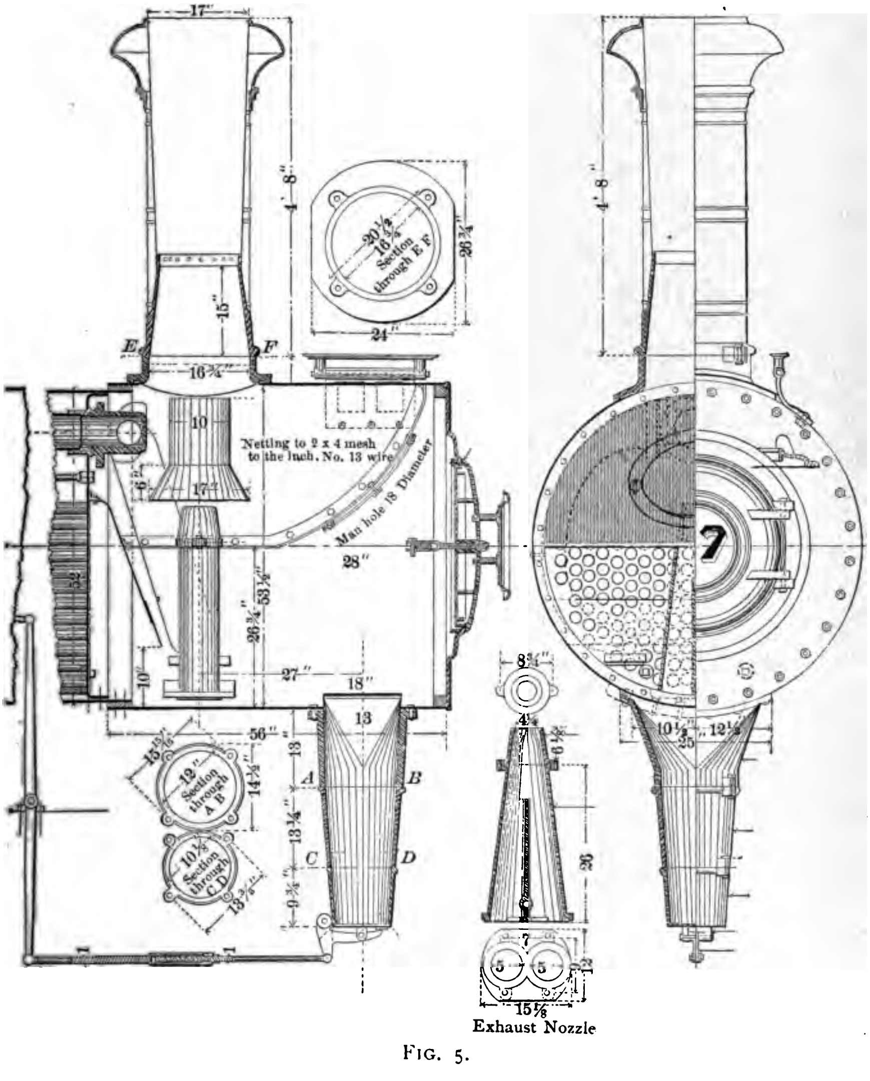

17"
1' 8"
15"
E
F
16¾"
20½
16¾
Section through E F
26¾"
24"
10
17"
Netting to 2 x 4 mesh to the inch, No. 13 wire
Man hole 18 Diameter
28"
53½"
26¾"
6⅛"
52
10"
27"
18"
13
56"
13
A
B
13¼"
C
D
9¾"
15 15/16
12"
Section through A B
14½"
10⅛
Section through C D
13⅞"
8¾"
4⅞
6⅛
30
7
5
5
12
15⅝
Exhaust Nozzle
1' 8"
7
10½"
25
12½

FIG. 5.

type. Cylinders, 17 x 24 in.; driving wheels, 62in.; weight on drivers, 58,000 lbs.; weight on trucks, 32,000 lbs.; total weight of engine in working order, 90,000 lbs.

Number of tubes, 2 in. diameter, 200.

Length of tubes, 11 ft. 11 in.

Length of fire-box, 72 in.

Depth of fire-box from crown sheet to top of grate, 67 in.

Width of fire-box, 34½ in.

Number of square feet of grate surface, 17.75.

Area of grate opening for air admission, 6.06 sq. ft.

Heating surface of fire box, 133½ sq. ft.

Heating surface of tubes, 1.084 sq. ft.

Total number of square feet of heating surface, 1,217½.

Number of square feet of heating surface to one square foot of grate surface, 68.6.

Length of smoke-box from flue sheet to inside of front ring, 57¼ in.

Number of cubic feet of space in smoke-box, 77.

Additional weight caused by extension front and attachments, about 1,200 lbs.

Number of square feet of total heating surface to one cubic foot of smoke-box space, 15.8.

Number of cubic feet of space contained in smoke-box to one square foot of grate surface, 4.33⅓.

Percentage of grate opening to total grate surface, 33½.

Percentage of stack diameter at smallest point to diameter of cylinder, 77.

Number of square feet of tube heating surface to one square foot of heating surface of fire-box, 8.12.

CONCLUSIONS OF COMMITTEE.

The Committee here lay the substance of their investigation before you, and from the evidence bearing thereon, together with their experience and observation, respectfully submit the following:

The heating value or combustible matter of different coals vary so greatly that it is impracticable to lay down a fixed rule giving the proper proportions of locomotive furnaces, their fixtures, and conditions, or any set dimensions of smoke-box that would be successful for all kinds of bituminous coal. A furnace with its attachments, and having a certain grate area and heating surface admirably suited to one kind of coal, and practically giving good results, would perhaps be, and often is, a partial failure with coal of another quality. Unsatisfactory results from the fire-box are often followed by condemnation of the smoke-box or its character, whether the latter is at fault or not, and it is plain that any changes made in the smoke-box or stack, when the fault is with the fire-box or its parts, cannot be productive of good results. The character and heating quality of fuel used on any road being determined by a few carefully conducted experiments, the parts for its economical use can be proportioned as far as practicable. If it is desired to test the efficiency of a furnace and its attachments, it should not be forgotten that the amount of coal burned is always an uncertain element, and a proper test is to base the efficiency on the actual combustible matter present in the coal. When the question is of the efficiency of the coal, then the evaporation should be based on the total amount burned, and no allowance made for non-combustible. In all cases the rate of combustion—that is, the amount of coal burned per square foot of grate per hour—should be carefully noted. If experiments are made, designed to reach the ends named, great care and ripe reasoning should be used in reaching conclusions, as often the smallest matters may change the course of important results, and thus lead to wrong impressions. As an instance, the writer, on one occasion, while conducting some experiments in an extended smoke-box of a locomotive, was, after certain changes, much disappointed in not getting expected results ; in fact, any change made, no matter how radical, fell short of those expected. Were it not that a former experience, under the same general conditions, had performed differently, the matter would have been given up as a failure ; but perseverance discovered the cause, which proved to be a leaky joint at the base of the exhaust pipe, and blowing forcibly toward the flue-sheet when the engine was working. This affair, though small, interfered very much with the action produced by the exhaust, and, on being corrected, the expected results were obtained. The fact of having no standard established basis or formula recognized by the Association for the purpose of conducting such experiments as would lead to the economical use of locomotive fuel, has often led to imperfect tests and consequent false and conflicting conclusions. In the opinion of your Committee the foregoing are some of the chief reasons that have caused the great diversity of opinion amongst master mechanics regarding the important subject under consideration.

EXTENSIONS.

Due consideration of the information received from practical master mechanics and superintendents of motive power in different parts of the country, together with the experience of your committee, prepares them to say that as spark arresters, and consequent safeguard against fire, cleanliness to trains and economy of maintenance, when properly constructed and within certain proportions, the extension fronts and open stacks are decided improvements in locomotives designed to burn the average quality of bituminous coal. Your Committee regret that no reliable statistics are at hand comparing its performance with the old style construction as a fuel economizer, but is forcibly impressed with the opinion that with a stack constructed on the ejector principle, or any principle tending to produce the most complete and uniform vacuum in smoke-box, it has also considerable merit in the direction named. Now, while the inside arrangement and their relative positions has much influence on the fire, any economy of fuel is not directly due to the extension itself; it comes from the increased area of exhaust nozzle, which is always permissible when the product of the exhaust has a free and unimpeded outward passage. The additional cost of construction, the slight increased weight thrown upon the truck, and the more trivial objection that the construction interferes with the process of washing boilers from the front end, are of minor importance and deserve but little consideration, if it is established that such departure from the old style serves any useful purpose and accomplishes any valuable result.

The volume of the smoke-box need not be dependent on accommodating the accumulation of a round trip; a receptacle for cinders attached to the extension, with a pipe leading to a point within a few inches of the track, the outlet governed by a valve handled from the engine cab, the accumulation would be under the control of the engineer, and could be disposed of at will.

From experiments made by your Committee with extension smoke-boxes of a greater and lesser volume, the relative dimensions given in the foregoing general dimensions of locomotive experimented on, were found to be productive of best results.

On appliances in the ordinary old style smoke box designed to accomplish the results obtained from well-proportioned extensions, your Committee are unable to speak, having had no experience or data from which to base conclusions further than the statement of gentlemen embodied in the report.

BRICK ARCHES.

From the testimony received as well as observations and experiments made by your Committee, it is clear that the use of a brick arch in the furnace of a locomotive designed to burn bituminous coal under ordinary circumstances, is productive of good results. Its position in the fire-box delays to some extent the currents and gases after leaving the fire, and largely assists their chemical combination and consequent combustion before entering the tubes. It is our opinion that brick for the purpose designed a few inches thicker than those in general use would be an improvement, the change would not only add to its serviceable period, but would be placing at a proper point a body of material capable of being highly heated, storing to some extent the energy of the fire-box, and might be said adding to the number of heat units contained therein. It also has the effect of promoting a higher and more uniform temperature, thus increasing the efficiency of the fire-box, as is attested by the reduced amount of black smoke produced, and without a corresponding reduction of temperature, a result that cannot be obtained under circumstances of a rapid rate of combustion in a furnace not so equipped.

Your Committee are also of the opinion that injuries to fire-box sheets, arising from the use of the brick arch, have occurred only where it has been the cause of unequal expansion of such sheets, and this could only be possible under circumstances where the brick arch is set close to or resting solid against them. In all cases there should be a space of one inch or more between side sheets of the fire-box and brick, and not less than two inches between the tube sheets and the latter. By this means a free circulation of uniform temperature is permitted in contact with one side of the sheets of the furnace, and with a free and necessarily unimpeded circulation of water on the other, the danger of any injury to fire-box, resulting from the use of the brick arch, is entirely removed. If the brick arch had no other features to commend it, than its influence in maintaining a more uniform fire-box temperature, and lessening the formation of smoke, it is worthy of the most earnest consideration. The assertion that its first cost and maintenance will not repay the advantages derived, should be based alike on its fuel-saving qualities, the reduced injury to passenger-car paint, and the value of largely abating a great public nuisance.

HOLLOW STAY BOLTS.

The quantity of air to be admitted above the fire by means of hollow stay bolts or otherwise, and the best relative position for its admission, is a matter that should be determined by careful experiment with the fuel to be used. If it is desired to admit air over the fire, care should be taken that it is permitted to enter the furnace as near the fire line as possible, so that it may mingle with the gases as soon as possible after they are evolved from the coal. Air for purposes of combustion, however, taken in through the grate bars serves a much better purpose, and is always a source of loss if a sufficient supply cannot be taken in at that point. Its passage through the under portions of the fire not only prepares it to more readily mingle with the gases on its arrival at the surface but, having absorbed a certain amount of dormant heat, and places it in active operation, assists to a great extent in maintaining a more elevated temperature than if the same amount was taken in at any point above the fire.

The good or bad features of admitting air above the fire is somewhat in the dark, not having been practically determined by experiment. It is a matter of great importance, however, and is entitled to much more consideration than it generally receives.

FIRING.

Much has been written and said about the necessity of careful, regular and intelligent firing, and this is quite correct, inasmuch as it is the only way by which a right supply of air can be introduced to mix with and consume the gases, and no. matter how efficient a furnace and details may be for the proper combustion of fuel, its ultimate success depends on the care and intelligence used in firing.

Carrying extremely thin fires has been warmly advocated as producing the best results from the coal used. Now, while your Committee are in favor of a moderately thin depth of fire, they can not from experience advocate a fire so thin that it will admit large and bulky volumes of cold air, thereby reducing, for a moment at least, the temperature of the fire-box to such a degree as will not permit a combustion of the gases. The fire contains a certain number of units of heat; if twice the amount of coal was in active combustion there would be double the number of heat units, and in consequence could more easily sustain a reduction of temperature following a fresh charge of coal, and by that means sustain a more uniform temperature, a situation of things that is always desirable.

All matters said and done relating to the economical use of coal on locomotives, will be fruitless of good results if the enginemen are ignorant of the simple rules of combustion and careless about educating themselves in this necessary branch of their calling. Enginemen showing a disposition of carelessness in the use of coal, or in any way ignoring the principles governing its economical use, are as much unfitted to have charge of a locomotive as if such ignorance and carelessness was shown towards the rules governing the operation of trains.

Without elaborating further on this important branch of our subject, we will close it by quoting a rule issued by a Western railway company and coming under the notice of your Committee: " It is a common practice for some firemen to throw a large amount of coal into the furnace at one firing; in this case the coal, being thick on the fire, cuts off the air supply that should come through the grates; in consequence the coal on top is rapidly coked by the heat underneath, and the gas and smoke (the very cream of the coal) escape unconsumed. An equal amount of coal placed in the furnace in three or four firings instead of one, would in many instances evaporate more water and reduce very much the amount of black smoke."

FURNACE.

The function of a furnace designed to generate steam is to produce the largest percentage of heat from a given weight of fuel, and with the greatest possible elevation of temperature of the products of combustion transmit to the water the largest possible amount of heat thus produced. Any amount of air admitted to the furnace in excess of that necessary for proper combustion is a detriment and a loss, as it not only takes out through the smoke stack a certain quantity of heat that otherwise would be utilized in making steam, but it diminishes the temperature of the furnace thereby impairing its efficiency as a heat producer.

On the other hand every pound of fuel requires a given quantity of air for its complete combustion, and must find it at a certain high temperature or the effect will be lost. The amount of air required varies with the extent of gaseous matter in the coal, but in every case less air than is required by the fuel prevents complete combustion and an excess of air causes a waste of heat, experiments having determined that the relative heating values of the gas and fixed carbon contained in the average quality of bituminous coal is as 14 to 16 when expressed in amounts of water that each would evaporate. Nearly one-half of the steaming value of the coal it will be seen is contained in volatile gases, and requires different treatment to that of the fixed carbon for complete combustion. It seems not difficult to construct a furnace or arrange its attachments for coal, such as anthracite having a single combustible element to deal with, but with bituminous coal we have the gaseous matter and the carbon to operate; a furnace properly adapted to work the gases will not be found equally efficient with carbon, and conversely, a furnace efficient to deal with the carbon will not produce the best of results in combustion of gases.

RATE OF COMBUSTION.

The velocity of draft and rate of combustion are some of the most important elements pertaining to the consumption of coal. To the rapidity of combustion in locomotive fire-boxes is due perhaps more waste of fuel than from any other source. It appears from experience to be impossible to extract from the coal its full heating value when the rate of combustion exceeds ninety pounds per square foot of grate surface per hour, and far more economical results were obtained when the rate was much less than the figures named. In order to utilize to the best advantage therefore the material necessary to the formation of steam—that is to say, the air and the fuel,—the fire should not be forced, but an augmented grate area, with a correspondingly increased furnace, are the necessary substitutes. The superiority from an economical point of view, of slow over rapid combustion, has repeatedly been shown by experiment. One case coming under the direct observation of your Committee, where, with a forced fire in order to get the engine to produce sufficient steam for her work, the evaporation was only 4½ to 5 pounds of water per pound of coal, whereas with an increase of 20 per cent. in furnace and grate surfaces to the same cylinder, and performing similar service, the evaporation rose to 6 pounds.

SMOKE.

Smoke is also a product of incomplete combustion, the entire prevention of which under circumstances of a rapid rate of combustion is attended with great practical difficulties. It has been proven beyond question that smoke once formed cannot be consumed. What is needed, therefore, is not a smoke consuming but a smoke-preventing furnace.

Every act leading to the proper combustion of coal takes place with increased ease, facility and completeness, as the force of the draft is lessened within certain limits; as the temperature in the furnace is more elevated and uniform; as the charges of fresh fuel are lighter and more regular; as the correct amount of air is admitted at the proper time, and as the contact is more intimate between the air and fuel.

The great variety of kinds of fuel, although containing nearly the same ingredients but in many different proportions, it is true, renders it a difficult task to arrange mechanically the means of utilizing all to the best advantage; but to lack of appreciation of the above mentioned facts, and of interest of the principles involved, is chargeable much waste of money, confusion of ideas and disappointments.

Committees: JOHN HICKEY,
W. A. FOSTER,
E. L. WEISGERBER.

SECOND DAY.

The Convention was called to order at 9 A. M.

DISCUSSION ON EXTENSION SMOKE BOXES, ETC.

THE PRESIDENT.—The first business in order is the discussion of the report of the committee on Extension Smoke-Boxes and Brick and other Fire-box Arches. The report was read yesterday and is now open for discussion.

MR. JOHN HICKEY.—I desire to apologize to the Convention for the length of the report, and yet there are many points connected with it on which the report is silent. The proper proportions of the entire grate surface, the advantages or otherwise of a fire door deflector, the relative values of the fire-box and flue heating surfaces, the proper construction of the heating surfaces that will offer least hindrance to the proper circulation of water, are subjects that are closely connected with that, but on account of the length of the report they have not been touched. I simply mention those matters to show that there are other subjects connected with it, that we have not spoken of. I take this opportunity of thanking the gentlemen who so kindly gave us the information from which we compiled our report.

SECRETARY SINCLAIR.—I move that the report be taken up under the headings that the committee have discussed it under and each one be discussed by itself.

THE PRESIDENT.—Is there any motion to that effect?

MR. LAUDER.—I second the motion.

The motion was carried.

SECRETARY SINCLAIR.—The first heading is "Extension Smoke-Boxes."

THE PRESIDENT.—The subject, then, for discussion at this time will be "Extension Smoke-Boxes." I hope the members will take hold of this so as to make it interesting.

MR. JOHN MACKENZIE, New York, Chicago & St. Louis.—I see the word "ejector" is used in here. I would like to hear from the committee what they mean by ejector. I would call it a funnel-shaped stack, or perhaps it is a succession of funnels making this ejector.

THE PRESIDENT.—Will the committee answer the gentleman's question?

MR. HICKEY.—The word "ejector" is used in there for the reason that the stack is made something like the tubes of an ejector by which water or other material is carried from one position to another.

SECRETARY SINCLAIR.—That expression, "ejector principle," in relation to the draft appliances of locomotives, has become somewhat common of late, and I think it is always used to indicate that the exhaust nozzle and the base of the stack are proportioned in such a way that they will do the work of exhausting the air from the smoke-box in the most effective manner, and the proportions are similar to the proportions of the tubes of the well-known vacuum ejector. I think that is the understanding of it, the single nozzle, and the contracted base of the stack with a bell-mouthed opening.

MR. MACKENZIE.—I might say that was my understanding of it, that the principle of the ejector, or the word ejector, was used for the purpose of denoting the stack as being smaller at the bottom than at the top; or, in other words, that the stack was opened up, relieving the friction.

THE PRESIDENT.—I understand Mr. Blackwell has been making some experiments.

MR. CHARLES BLACKWELL, Georgia Central.—I think you have been misinformed. I have not been making any experiments lately.

MR. JACOB JOHANN.—I do not know that I can enlighten the members very much on the matter. I have not made any very scientific experiments on testing that ejector principle, as they call it, in smoke stacks, and if any member has I should like to hear from him and see the difference in the results he discovered. Now, in the first place, it is not very new. In the next place, as far as I have gone into it, I have not found any very material benefit in it.

Within the last eighteen months I took occasion to give it just an informal trial, and I have long since made up my mind that if I wanted to know anything about the working of an engine that it probably would be as well not to let the engineer know what he had got. The first point to find out is to see whether there is any difference in the operation of the engine. I had three stacks prepared in a quiet way with this contraction arrangement inside, and they were stowed away; and in due course of time some engine was in the shop and wanted a little work done to it, and the old stack was taken off and this stack was put on, and the engine started out with the same crew that it had before, and the thing went along and in the course of two or three months I probed the engineer a little to see if he had discovered any difference, not saying what there was about it particularly, but asked how his engine worked, and he could not for the life of himself say there was any difference. Neither could I, and from those results I simply stopped putting any more of them on, because I did not think that we were getting any very particularly advantageous results over the ordinary stack. That is my experiment with ejector smoke stacks. Of course, the proof of the pudding is in the eating of it. If some gentleman has made scientific tests, and kept account of his coal and everything, he can probably give information on the subject.

THE PRESIDENT.—It has been suggested that Mr. Gibbs has been making some experiments.

MR. GIBBS.—For some time I have been using a cast iron stack which is very much contracted—about eighteen inches above the base of the smoke stack. I found that the East Tennessee people were getting some excellent results from their single nozzles and stacks, and I tried them, and I found that I was not getting what I expected, and in changing around I found that the ordinary proportion that fills up the straight stack near the top, did not seem to fill out this double cone stack, and I had to drop down towards the centre line of the boiler. Then we began to get good steaming results. With our eighteen and nineteen engines we dropped down to fifteen inches. I have been trying two kinds of nozzles, a high and low, and I found a difference of about a quarter of an inch, by dropping down to nearly the centre line. Then we tried making a nozzle that was telescopic, the upper part telescoping into the lower part. We started at the old position at about the diameter of the stack below the base, and got inferior results, and kept lowering, and the lower we got the better it seemed to be; but we could not get down to the centre line with that. Owing to an accident to the engine, we have not been able to carry the experiments any further.

MR. J. M. BOON, West Shore.—We found in using a straight open stack, a difficulty in getting steam, the boiler, in our experiment, being a rather poor steaming boiler. The change in stack made the diameter of the outside shell about eighteen inches. We put an inside pipe in, and reduced the taper to about fourteen inches, running from eighteen inches to fourteen inches for about two feet; then running it out again, making it about sixteen inches at the top. We found by having the stack in that way that we got a better steaming engine; we could increase the diameter of the nozzle. After we drew the stack in, the nozzle could be enlarged, and finally we made a very fair steaming boiler out of one with which it was very difficult to get steam at all on a hard run. We had trouble with steaming in anthracite coal burners. The stacks originally were tapered, but the smaller part of the stack was too large; it was originally fifteen inches. We drew it in another inch and we found a decided improvement in the working of the stack. The engines steamed more freely and naturally with a larger nozzle. That is the result of a hundred and fifty locomotives. In every instance, by contracting the stack we improved the steaming.

THE PRESIDENT.—I would like to ask Mr. Boon what was the actual difference made in the size of the nozzle between the two stacks.

MR. BOON.—Well, the engines were running with two exhaust pipes and they were running about 2⅞, and by changing the stack we ran them up to 3⅛.

MR. J. N. LAUDER, Old Colony.—I have had perhaps as much experience in the last four years as almost any of you in this matter of the extension smoke arches and straight stacks, and I am very much in favor of them. I have changed in the last four years some one hundred and fifty engines from the old diamond stack arrangement to the extension smoke arch and the straight stack, and I think in every instance the engine has been made better as to its steaming qualities. But there is one thing which I find in my practice that is different from a great many. I use a single nozzle, while I find a great many of my neighbors are using the double nozzle. I do not know that the consumption of fuel is affected very materially by one system or the other, but I think that the single exhaust will run very much cleaner than the system of having two nozzles. We are running our seventeen-inch cylinder engines with a 4½-inch nozzle. In fact, we have some seventeen-inch cylinder engines with exceptionally large furnaces, that are running with 5-inch nozzles, and making all the steam that is necessary to haul a heavy train. Our 18 by 24 engines are running with 4¾ to 5-inch nozzles and making 170 pounds of steam and hauling twelve to fifteen cars. They run exceptionally clean and I think it is largely due to the large single nozzle. The exhaust is very light and the action on the fire is consequently light compared with the small opening of the double nozzle. I recently have come to the conclusion that, as a rule, we get our nozzles too high. That, I suppose, comes about by the practice of carrying the horizontal netting in the smoke arch from the top of the flues out, and it is necessary, of course, for the exhaust nozzle to project through—it is convenient to have it project through enough to get the tip above the netting. In several cases I have lowered the netting, with good results. I think it will make the engine steam better to drop the top of the nozzle about to the top of the top row of flues—possibly lower than that.

I think that matter of stacks is about as Mr. Johann has stated. I have got stacks running contracted at the base and opened out at the top. I have got them just the reverse of that—contracted at the top, and I have got them straight, and I have so far failed to see any particular difference. I believe that just a plain, straight stack of proper diameter is all that is needed. I believe you get as good a vacuum in your smoke arch and make steam as easily as you would with a lot of expansions and contractions inside of the stack. My diameter of stack is 17 inches, inside diameter, for 17 and 18-inch cylinder engines. I have tried smaller ones and larger ones, and have found that the 17-inch stack gives us as good results as any other size that I have experimented with. For convenience, we have the same diameter of stack for the two engines, and I fail to see any difference in the working of an 18-inch cylinder with a 17-inch stack or with something smaller. The height of the exhaust and the proper size of the exhaust tip, having it centrally located in the center of the stack, and the form and position of the deflecting plate in front, I think, are the essential points to make an engine steam well with an extension smoke arch. Of course I thoroughly believe it is absolutely necessary to run a good brick arch in the furnace where the extension smoke box is used, to get the best results, especially in cleanliness. Without the brick arch in the fire box, you will get more or less smoke, which we want to avoid on passenger trains, and we also get more sparks thrown, I think, and more collected in the smoke arch than we should have with a good, well constructed arch in the furnace.

In connection with this, I would like to call the members' attention to one point that I discovered. I put in a brick arch in all new boilers and in some old ones, with tubes running from the flue sheet to the crown, to support the arch, and I had one of those tubes burned out; that is, it had all the appearance of having been hot, and of course that showed me that there was no water in it, because with water in it could not have got very hot, so as to have injured it. After considering the matter I made up my mind that the trouble was that the bottom end of the tube which goes into the flue sheet ought to project into the water space, beyond the flue sheet, say an inch and a half or two inches, to be sure that the bottom end of the tube lies in solid water, so that the water entering that tube will be water and not mixed with steam. The tube that apparently burnt out only just projected through, even with the water side of the flue sheet; and my theory is that when an engine is making steam rapidly and there is a very hot fire in the furnace, solid water does not come in contact with the flue sheet; it is in a semi-steam state, and the tube is not fed properly with water, and before the latter could get up through it was converted into steam, allowing the tube to overheat and burn. By letting the lower end of the tube project through the flue sheet, it gets it into solid water, so that at all times there is the solid current of water starting into the tube, and before it gets through it would not become very hot steam.

Then, again, as to the method of fastening those tubes in: it has been in some cases rather a delicate and bothersome job to put those tubes in in a cheap and substantial way and have the tubes last. The first that I put in several years ago I cut threads on each end of the tube and I fitted a slip nut with the thread corresponding, that would turn freely on the tube and the thread on the outside of the slip nut tapering to screw into the flue sheet; then put the tube in place and screwed the nuts in until they were home. That made a very substantial job as far as holding the tube was concerned, but it is rather expensive, and I found the tubes would not last put in in that way; they would break at the lower end at the root of the thread, the thread having cut the metal away so much that it was weakened and all the strain of the pipe under different temperatures concentrated at the weakest spot, which was at the root of the thread, and the tube would break off. I then tried to find out if I could not get rid of cutting the tube away. I now simply straighten the tube, put it in a lathe and skin it over, just turn it enough to true it; then slip on the sleeve with a fairly good fit; then, cutting the thread on the outside of the sleeve tapering to correspond with the hole tapped in the plate, put them in and screw them up tight and it compresses that composition so that it hugs that pipe tight enough to make a thoroughly substantial and reliable job I never had one leak and never had one break since I put them in that way, and it has the merit of being extremely cheap.

THE PRESIDENT.—Is Mr. Forsyth present? It has been suggested that he has been making some experiments with a peculiar kind of nozzle. I think it would be interesting to the members to hear from him in regard to it.

MR. WILLIAM FORSYTH, Chicago, Burlington & Quincy.—I have had very little experience with extension smoke boxes, and the experiment that I made with a nozzle was really not an experiment and I think the result would not be of much value. We did not get it just right to have it steam properly. It was an annular nozzle which I believe is a more efficient form than the ordinary circular nozzle, and if properly made would I think produce a very good result.

THE PRESIDENT.—Is there any further discussion under this head?

MR. MACKENZIE.—I move that the discussion be closed.

The motion was carried.

The President.—The secretary will please read the next division.

BRICK ARCHES.

Secretary Sinclair.—The next division is brick arches.

The President.—Brick arches is the subject now under discussion.

Mr. Johann.—I wish somebody would get up and say something about brick arches. The members certainly ought to have something to say about them. I used brick arches away back in 1860, and while they have some advantages, I think there are some disadvantages, and coming to put the two in the scale, I think the disadvantages almost pull the advantages down, and I do not use them. I get along with an ordinary, plain fire-box, but there is no question that a brick arch put in nicely will retard the ejection of the cinders and probably a fire may be controlled a little better. There may possibly be some advantages in it, and some of those gentlemen who are using them now ought to give us their experience on the subject. I would like to hear from some of them.

Mr. T. W. Gentry, Richmond & Danville.—I was going to suggest, when Mr. Johann got up, that some of the gentlemen who had some reason to doubt the efficiency of brick arches should get up and ask for some experience on them. We have been using the brick arch so long on the Richmond & Danville that there is no longer any doubt in our minds on the ground of economy. We use it for two reasons: one is the matter of cleanliness on our passenger trains. It improves our engines in steaming, we get better results in economy of fuel, and we find that we like it so well on passenger engines that after we had got our service tolerably well equipped we commenced it on freight engines and we kept it up. We support the arch with a heavy tube, much on the style that is mentioned by Mr. Lauder. We screwed on one end of it and we have a great many that have both ends screwed. We have never had much trouble with our tubes breaking when they are threaded, because we use a very heavy extra hydraulic tube. We have had some pipes to crack at the root of the thread, but we found most difficulty in the pipes burning and getting thin gradually from the action of the fire, notwithstanding the fact that we have never had them get empty. If we get pipe, however, that will last two years or two years and a half, we think it is worth our trouble to put it in again. I think that anybody who will put in a brick arch as it should be put in, and get its position properly located, cannot help seeing a result that would induce him to continue. We have given the matter study, and I see no reason in the world now to depart from the practice of using the brick arch. We put it in every new engine we build. We are very careful to select a good quality of brick, and we put in not less than three pipes, sometimes four. There is an advantage in putting in a fourth pipe, because it allows you to use bricks after they are broken in two. We have also had a large experience in putting the brick arch in, even in small engines. We have never failed to get a fair result. Certainly it has never retarded the steaming capacity. We have improved the cleanliness of all classes of engines. We have tried it with engines with short front, diamond stack, and proved beyond a doubt that there is a slight economy there also. I believe our passenger trains are probably hauled with as little dust and cinders as those on other roads in the country. I have traveled much lately over some of our best roads, and I have never seen any trains that are hauled any cleaner than ours. It has certainly reduced our expense for cleaning passenger trains. We do not have as much expense in fires along the line of the road, and we do not have our furnishings and paint cut away as we did before putting them in. We are very careful not to allow our arch to fill out to the sides of the sheets. We have a good hearth brick that goes next to the tube sheet. We have a regular practice of going in and cleaning off the tops of the arches at stated intervals. We find that unless we keep the arch clean on top, it gets dirty, chokes up and sometimes becomes an obstruction. I think if gentlemen will put in the brick arch properly—the combination of nozzles and deflectors and extension fronts, or even in a short front—that they will find it will pay them to put in a brick arch and maintain it there.

MR. J. M. BOON, West Shore.—The matter of brick arches came up with me some years ago while connected with a road in the West. I made a series of very elaborate experiments with it. We found that by running the brick arch we made an increased mileage of seven miles with a ton of coal, running the same engine with the same train, under conditions as nearly alike as possible, taking the arch out, running the engine without it, then putting it back and running it again; the result came out an average of about seven miles better per ton of coal. We also found the engine ran cleaner, with less cinders thrown from the stack, and found that the engine steamed more uniformly. We found no special difficulty from any damage to fire box. The engine ran without showing but very little smoke. When the engine would be worked up to the utmost limit of her power then there would be smoke. The reason was, there was not time for the gas to ignite and burn. On the road I am connected with now, all the engines are equipped with brick arches and we find a decided benefit in their use. We have had some trouble with consolidation engines and we abandoned the use of the arch temporarily, but we continued to put the brick arch in all the passenger engines.

MR. JOHN HICKEY, Milwaukee, Lake Shore & Western.—It will be noticed that a great many members take exception to the brick arch on the ground that it is an injury to the fire box and sheet. I would like to hear from some of those members as to their experience. I have been unable to discover any of those injuries when the arch is properly put up. We put it up with a space about two or three inches between the flue sheet and the arch, and about an inch space between the side sheets and the arch. In that way we have uniform temperature all around the inside of the fire box, what we cannot get if the bricks are resting solidly against the sheets. We also found by experiment, that with the same quality of coal and under similar circumstances, we got an increased evaporation by the use of the arch. We found without the arch we got an evaporation of 5½ pounds of water to the pound of coal, while with the arch in use we got 6 3-10 pounds of water with the same quantity of coal. I would like to inquire from the gentlemen wherein they find the trouble from injuries to fire box sheets in the use of the arch.

THE PRESIDENT. Mr. Swanston and Mr. Shaver, of the Pennsylvania lines, are present and have had a good deal of experience with brick arches.

MR. D. O. SHAVER, Pennsylvania. They have been using the brick arch on the Pennsylvania road ever since I have been there—twenty-one years. We generally have a space of about three inches next to the flue sheet, and about an inch and a half to two inches on the side. We have never yet found any trouble with fire boxes, and the engine steamed better by giving that space. If you make them tight they generally do not steam quite so well. For that reason we put in the space.

MR. WILLIAM SWANSTON, Chicago, St. Louis & Pittsburgh. That is about our experience. We use the brick arch, but on our passenger roads we have considerable trouble with the water we have, the tubes filling up, and we have been using the angle iron and letting the arch rest on the side. We have found no difficulty with that when the arch was pretty well rounded. If the circle was not great enough so that the expansion would allow it to go up and to form a straight line, as a matter of course it would press out. In that case we frequently had stay bolts leak. Where it was rounded there was no trouble. We have used arches on those angle irons for several years, and found no difficulty with the sheet whatever.

MR. W. H. SELBY, Chicago & Atlantic. When I was on the Northern, I used the brick arches for about eight or nine years. I left a space of about four inches between the arch and the flue sheet, and about an inch and a half at the side. I experienced no difficulty whatever with the flue sheets or side sheets giving out. We experienced the saving of about six miles per ton of coal in our passenger service, and I do not know that I heard of a side sheet cracking on account of the brick arch. I think that if the members will put them in properly there will be no trouble. In the first place, I used the tube. But after a while I found that the tubes wore out, and I went to work then and got a two-inch square piece of iron and turned it up to an inch, tapped it to the boiler, and left the loop on the outside, resting my brick on those loops, and that held them up. After the Wabash got hold of us we discontinued the use of them, because they were not adopted over the entire system. Consequently the brick arches were dropped.

MR. T. W. GENTRY, Richmond and Danville. We have some engines that are doing their eighth year of continual service with the ordinary iron fire boxes, that never gave us any trouble. I made a personal inspection of staybolts and crown sheet bolts on an engine that had an arch running continually for seven years, and I could notice a little difference, of course, on the crown bar bolt heads inside of the crown sheet, where they were exposed to the nearest approach of the arch to the sheet. There was evidence there of a gradual cutting or wearing away, but we had succeeded in keeping them tight for eight years.

MR. JOHN ORTTON. I would like to ask some of the gentlemen about the size of the fire bricks. Much, I think, depends on that. My experience has varied very considerably between the fire bricks and the midfeather on the New York Central. We have four bricks put in there. We use no angle iron, but we put studs in the side sheets. We chisel out holes on the sides of the bricks where they rest on those large studs, and form an arch so high that the material is entirely supported. The arches remain intact, and the only trouble that we have is occasionally when the tubes leak. If that is so we have to take out the brick, and invariably the bricks do not go in again. The midfeather or water-table that we used there is an absolute preventive of all smoke. You may poke the fire as much as you like; you can not get any smoke out of the stack. I know that the application of that, together with the single exhaust, has reduced the bills for the fuel expenditure quite 40 per cent., from actual experience and from careful experiments. With respect to brick arches being used, for 17-inch and 18-inch engines we have an arch about twenty-four inches in width. We place that about twenty-two inches from the flue sheet, and the collars on the side sheet keep them from going right up against the sides, and I have never noticed any difficulty whatever with them, so I think a considerable amount of value is due to the fire brick. The midfeather or water-table is certainly an admirable preventive of smoke. Experts have been there experimenting with it, and we have tried with the commonest coal we could possibly get, and by raking up and so on we could not see a vestige of smoke coming out of the stack. I think Mr. Sinclair could say something on this point, for he has been there.

MR. GEORGE W. STEVENS, Lake Shore & Michigan Southern. I believe in reducing these experiments to cold figures. Before we started in to use a brick arch we made a test, which I will read. It shows some comparison as to extension front without the brick arch, also a straight stack without the brick arch and ordinary smoke box. A straight stack shows an evaporation of 5.71 pounds of water per pound of coal; a diamond stack showed 5.76 pounds of water per pound of coal; a straight stack and extension front showed an evaporation of 5.80 pounds of water per pound of coal; a straight stack, extension front and brick arch showed an evaporation of 7.03 per pound of coal. Now, I believe, and have made experiments to demonstrate, that the brick arch prevents the emission of cinders fully 25 per cent. Now, I think it is the sentiment of this Convention that the brick arch is a desirable acquisition to locomotive service. It prevents sparks. It prevents the emission of smoke fully 50 per cent. I am going to make a motion, in order to get at the sentiment of the Convention, that it is the opinion of this Convention that a brick arch is desirable for locomotive service.

The motion was seconded.

THE PRESIDENT. Gentlemen, it has been moved and seconded that it be the sense of this Convention that the brick arch applied in the fire box is a desirable addition to a locomotive for any kind of service.

Secretary Sinclair. I wish to say a few words on the brick arch. I was in at its birth. I was brought up under Thomas Yarrow, locomotive superintendent of the Scottish North Eastern, who first applied a brick arch to a locomotive, and I had considerable to do with the experiments that were made to test its value. An arch was made just of common fire bricks like the ordinary building bricks, and put into the fire box of one engine, and she was run a certain number of miles on a regular train with a brick arch. Then the arch was taken out and the engine was run without it. These were the preliminary experiments for it, and the saving was demonstrated to be so important, that the device was adopted for all the locomotives of the road. Afterwards I fired engines with a brick arch put in in that way, and the coal consumed was very carefully kept account of—much more carefully than it is on most roads that I have been connected with in this country or am acquainted with, and if the engine men on one engine were using more coal than others they were brought pretty sharply to account for it. That being the case, the engine men would no more think of running without an arch after it fell down than they would of running without a fire door. It not only caused a very important saving of fuel, and the engines would steam much more freely, but there was an entire absence of smoke, that is, with the admission of air and careful firing. So that was exhibited as one of the greatest improvements that had been effected on the coal-burning engines of that day. It came out when they were changing from the use of coke to coal, and it went very far to doing away with the objections that were readily raised there against the innovation and nuisance of smoke. Locomotives had been run burning coke entirely, because the public would not stand the smoke nuisance, and the brick arch enabled the railway companies, of Scotland anyhow, to introduce coal burning without giving offense to the public.

I have paid a great deal of attention to the subject since I came to this country. When I have seen people using brick arches, I have always questioned them as to their experience with them. When they were not using the brick arch, I always wanted to find out why it was not used. I think that the objections that have been raised to the brick arch have mostly been trivial, and objections which are not creditable to the master mechanics of America. There are certain difficulties with the sides of the fire box, and I think that it is the duty of master mechanics to use proper means to overcome these difficulties, and if one man uses a brick arch and effects a saving of 10 per cent. or 15 per cent. or 25 per cent., as the case may be, another man can do the same if he uses the same means to get at it. The fact of the matter is, there is too much guessing about the value of appliances. Many men put in what is called an improvement, and they ask the engineers what they think of it, and it depends very often on a man full of prejudices whether the thing is going to be a success or not. That is not the way of doing business properly. If a thing has merits it ought to be subjected to intelligent tests, and when a change is made on a locomotive or any part of the draft appliances, it very often entails some other changes to regulate it; and merely to put in an improvement and not paying any attention to adjustment, is putting a thing in and giving it no opportunity to show what it amounts to. I am satisfied that the more the brick arch is used the more it will become popular. As far as I have seen, those who use tubes for supporting the arch are most successful. I think the water tubes do a double service. They keep up a circulation of water that is very useful in increasing the evaporating effect of the gases, and the objection to that—that the tubes sometimes burn out, is merely the objection that can be made to everything else—it wears out. These tubes have a life to them, and it ought not to be very difficult to find out what is the life of a tube for the water you are using, and the tube should be removed before it wears out or burns out.

MR. SHAVER.—I would say in regard to burning out, I have never known one to give out yet from burning unless it was stopped up from one cause or another. Sometimes waste may be left in the boiler and the waste gets down into the tubes. If the waste stops in the bend it is about a five minutes' job to burn the pipe out.

MR. ORTTON.—I fail to see where the advantages of these tubes are. I do not think they are a necessity. My experience goes to show that there is no necessity at all for them if the brick are properly shaped. The bricks are self-supporting. There is really no wear or tear about them. The bricks will stand there for a year easily, sometimes longer than that. If the tubes leak we have to take them off; that is the only inconvenience that we have with them. I asked a few minutes ago about the size of the bricks used by members. Much depends, I think, on the size of the bricks. I would like to know as to that. We use only four bricks; that is, two in the fore width—two solid chunks 6 inches long by 16½ or 18½ inches. We put two rows of those. That gives a brick table of four bricks. If the members use small bricks there may be a necessity for putting in angle iron and tube and things of that kind.

MR. O. STEWART, Fitchburg.—I would say that it has been the practice of the Fitchburg road for thirty years or more, as I have known them, to use fire brick, always set upon studs, screwed into the side of the box. Our custom at the present time is that the nearest point of the brick arch and the tube sheet shall be three inches at the top of the arch. On a 78-inch box we use six brick 12 inches wide by 6 inches thick. On a 54-inch box we use four bricks of the same size. Our experience has been about as has been stated by the rest of the members here. We get, on our passenger train, from seven to ten miles more to the ton of coal with a brick arch than we do without. Sometimes our arches fall down on the road and the men take them out and they want to try for a little while without the arch. They say they can get at their tubes better to clean them out through the fire box door than they can through the smoke arch, but it is a very short time when the fireman will come around and want his brick arch put in again; he has to throw too much coal. I think that is a pretty good criterion to go by too, although it is not "cold figures," as our friend here says. But when our firemen begin to complain about having to throw too much coal without the arch, I like to give it to them—let them have it.

Mr. Stevens.—The reason I like these figures is because they eliminate all questions of opinion and get right down to bottom facts. That is what we want. We can get up here and recite our opinions day in and day out, and everyone knows, if he will honestly acknowledge his experience, how many times he has been mistaken ; that is, he has formed some idea and cherished it and had it fixed in his mind that it must be so. He goes on and makes his experiments, and, lo and behold ! it turns out entirely different. That is why I like statements based on weights—on evaporation.

The question of smoke stacks—that is the way that should be decided, as to the best form of stack.

The President.—The question is upon the brick arch.

Mr. Stevens.—I beg pardon if I am out of order, but I wanted to answer Mr. Ortton's question as to the size of brick that is used. It is our practice to use a brick 4 inches thick and 8 inches wide, a sufficient length to reach the entire width of the fire box. The arch is carried back within 25 inches of the furnace door and within 16 to 18 inches of the crown sheet. In getting up designs for these bricks, I solicited opinions from persons that I thought had used a brick arch for the longest time. My opinion is that that is the best size of brick to use, and I think that is the commonest size. Mr. Lauder has an excellent device ; he is to be complimented on it. I use it to a certain extent; that is, I use it where there is not sufficient room between the crown sheet and the furnace door to get in the tubes the other way, set in the form of tubes in the sheet. I use that because it costs 33 per cent. less to put them in than by Mr. Lauder's method. But, as I said, he has a very excellent method.

Mr. Peter H. Peck, Chicago & Western Indiana.—We have used brick arches a good many years. I have put them in 16 inches from the crown sheet, and from 20 to 24 inches from the back sheet to the center of the brick arch even with the bottom row of flues. On the bottom flue I have put a piece of iron with a lag on it and built the center of the arch against it, and I use angle iron, the same as the gentleman on the New York Central.

Mr. William Swanston, Chicago, St. Louis & Pittsburgh.—In regard to the thickness of brick required in an arch that is supported on the side, I notice the gentlemen talked about six-inch brick; we use only four-inch. I do not see any use for anything thicker than four-inch. We can hold up an arch just as long as it can possibly be held in an engine—as long as the flues will last, for that matter, with a four-inch brick. We use the angle iron. We use simply three ⅝ studs to support the angle iron, and the brick is so formed that the angle iron is altogether inside the brick, not exposed to the fire at all, and that will stay there just as long as the flues will stay. Of course, you have got to take out the brick arch if you want to work on your flues.

Mr. John Mackenzie, New York, Chicago & St. Louis.—I am very glad that this expression of the members has been brought out about the thickness of the brick. The question of the length of the arch does not seem to me to cut so much a figure as its thickness. If we can get a brick eight inches thick hat is properly burnt, I believe it is of much more value to use than a four-inch trick, for the reason that every time the door is opened the four-inch brick is cooled so much more rapidly than the eight-inch brick that the combustion is not so perfect. We commenced at four, and we have gradually gone up to seven; but the difficulty is to get them properly burnt, so that the brick is burnt in the centre. The main complaint with the makers about them, is that they have got to keep them in the furnace so long that they can make no money on them. I would like to hear somebody's opinion about the thickness of the brick.

Mr. Selby.—From my experience I found that a six-inch brick was about the best thickness to carry. You get them better burnt than a thicker brick, and they do much more service than a thicker one. I was in the habit of using two bricks, simply joining them in the centre. I had them made especially for the mouth of the fire box, about twenty-five inches from the door. I am fully convinced that a six-inch brick is the brick to use.

Mr. Mackenzie.—I call for the question.

The President.—It has been moved by the gentleman from the Lake Shore & Michigan Southern, Mr. Stevens, that it be the judgment of this Convention that a brick arch applied to the fire box of the locomotive is a desirable addition for all service, and a positive advantage.

A standing vote was taken; 62 members voted in favor of the motion, and none against it.

The President.—All the members have not voted, by any means, and yet as it stands it is unanimous in favor of the brick arch.

The Secretary will please read the next subject.

HOLLOW STAY BOLTS.

Secretary Sinclair.—Hollow stay bolts.

The President.—Is there any discussion on the subject of hollow stay bolts?

Mr. W. J. Robertson, Central Vermont.—It seems to me that most everybody here has had a great deal of experience with hollow stay bolts, and as our time is getting limited and as the report of the committee covers about everything, I would like to make a motion to the effect that if anybody has anything very valuable on hollow stay bolts that he bring it right up.

Mr. Ortton.—I am of the opinion that stay bolts for the admission of air to the fire are of no value, for the reason that the air, when it gets there, is too close to the tubes to be carbonized, if I may so call it, and unless you can get the air in the right place for the hot flames to combine with it, the air has a tendency to pass through and cool the fire box. The proper place to get the air is undoubtedly below the fuel. With a proper grate area, a proper means of getting the air to percolate through the fuel, and having the fuel rather thin, by admitting the air underneath the fuel you get it in the right place. It gets heated then. But if you admit cold air above the fuel, there is not much chance of the admixture of the gases.

SECRETARY SINCLAIR.—Those who have used deflectors on the fire-box doors, and found that they could get them to stand, have nearly all been in favor of admitting the air above the fire. The experience with hollow stay bolts shows that some are for them and some are against them. The fuel that is consumed in the grates requires a certain quantity of air, as we all know; if you get enough air from beneath, it is a disadvantage to put in any above, but if you are not able to get the required quantity of air from beneath, you will save fuel by getting air in from above. So far as I can judge from the experience I have had, and from watching engines equipped with hollow stay bolts, the difficulty has been that there is no proper means of regulating the air from beneath. At one time, when the fire is clean and a full quantity of air comes from below, the hollow stay bolts are not needed. The air coming through the hollow stay bolts is a disadvantage at that time. If the dampers were capable of being so regulated that the fireman could close his damper sufficiently when the fire was clean, so that he could utilize the air that was always coming in from above, and not have too much coming in from below—just having the means of regulating the supply to the demand—there would always be an advantage, I think, from using hollow stay bolts, because when the fire got dirty and got filled up with clinkers and dead ashes before the end of the trip, then you would begin to get the air when it was needed, and it would prevent the gases passing off without being properly consumed; that is, the supply of air would prevent gases from passing off in the form of carbonic oxide instead of carbonic acid, which is the full product of combustion. Those who have tried stay bolts as a means of admitting air above the fire have had fairly good success where the means of regulating were attended to.

As the report rather sits down on hollow stay bolts, I wish to give that as my opinion of why they are supposed to be a bad thing by some and a good thing by others.

THE PRESIDENT.—Mr. John Player, of the Wisconsin Central, has had considerable experience, I believe, in that direction.

MR. JOHN PLAYER, Wisconsin Central.—My experience with the hollow stay bolts is that they are very necessary for combustion, just as much so as the brick arch. I am of the opinion that the brick arch without the stay bolts, or a deflector over the fire door, would not amount to very much. I think the admission of air over the fire through the stay bolts is one of the best preventives of black smoke of all devices that we have tried.

MR. WILLIAM SWANSTON.—I have been rather in favor of the hollow stay bolt. I use for a hollow stay bolt a 2 inch flue, according to the length of the fire-box. In short boxes I put in four, in long boxes I put in five on each side; none in the end. Of course it is largely a matter of opinion, you may say, as I have made no exact experiments; but I think that we have a much cleaner engine by its use and less smoke. Some time ago I had a passenger engine that had no tube, and I had several others that had tubes in, and I noticed that the engine without the tube was making more smoke. I rode behind it several times for the purpose of ascertaining just what the result was. The question of whether the air tube was an advantage was one that was not clear in my mind. On this occasion I took the engine in ; made no change whatever except to put four hollow stay bolts in the side. The engineer, of course, was fully aware of what was done. I desired him to make no difference in the running of the engine—not to endeaver to make the experiment a success, but simply use the engine as he had done before, and we had a marked improvement in the quantity of smoke that escaped from the smoke stack. I was satisfied from that experiment that these hollow tubes were an advatage so far as cleanliness was concerned.

MR. T. W. GENTRY.—I would like to ask if they noted any increase in steaming capacity. I suppose hardly any of us doubt the advantage of hollow stay bolts to admit air and lessen black smoke, but do we actually increase the steaming capacity of the engine, or if we are going to use them, I would like to know how many we are to use. In the remarks I made in the committee, I did not advocate the use of them as an adjunct to making steam. It is certainly an excellent idea to use hollow stay bolts, if for no other reason than that we can locate them when they are broken. I believe, if judiciously put in and not too many of them, that probably they would be an advantage. For the lessening of black smoke, there is not any doubt about there being an advantage, but it is doubtful if the engine will steam as well. I have certainly not been able to increase the steaming capacity of the same engine by admitting air over the fire.

MR. L. AMES.—In regard to the hollow stay bolts we have consolidated engines with hollow stay bolts and some without. I use a two inch tube, six on each side. We are getting very good results. The engines steam more freely. I have never tested the result as to the saving of fuel, but the feeling of the men is, that with the hollow stay bolts the engines consume less fuel and steam more freely. They are certainly cleaner running engines. We do not use the extension front for a spark arrester. We have it, so there will be plenty of air taken in at the bottom, and also plenty of air in from the sides of the fire-box and we get lots of steam. We find that those engines that have not got the hollow tube, draw more cinders through the flues. We find sometimes that the machinery is covered up and the cinders scatter back over the driving box. On the engines with hollow tubes, we never find a cinder back on the machinery. It seems to me that we burn the most of the fuel up in the fire-box.

MR. JOHN ORTTON.—I would like to ask Mr. Ames if I understand him correctly to say that he has not an opening under the smoke box? Isn't there trouble from fire?

MR. AMES.—I would say there is nothing there to take fire. It does not arrest the sparks, for what come there are led right down to the track. For two years there never has been any complaint of fire.

MR. G. W. STEVENS.—I do not know whether this discussion is in order where it has got to now, but it seems to be allowed all the same. I would inquire of Mr. Ames for what purpose he uses the extended front, if it is not for arresting the sparks?

MR. AMES.—I will state we need a little room there for the sparks to come out and go down through. We can hardly get it without the extension front.

THE PRESIDENT.—Gentlemen will please remember that the subject under discussion is hollow stay-bolts.

MR. STEVENS.—It just occurred to me that I am on record as using hollow stay-bolts. It is perfectly proper that I should give some explanation for it. That is one of the things I believe in, but there have not been any cold figures for it. I believe in using a bolt with a small hole, for the reason that you admit the air in smaller quantities, and there is a better chance to perfect combustion than there is when the air is admitted in larger streams.

MR. LAUDER.—I move that the discussion of this question be closed.

The motion was carried.

THE PRESIDENT.—The Secretary will please read the next subject,

SECRETARY SINCLAIR.—Firing.

THE PRESIDENT.—The next division of the report is on the subject of proper firing for locomotives.

MR. JOHN MACKENZIE.—Mr. President, if I am in order I move that we pass to the next subject.

The motion was seconded.

MR. JOHN ORTTON, New York Central & Hudson River.—I think that this question of firing is one of the highest importance. I think it is the most important thing that there is. If there is anything to be done with a locomotive, especially in regard to economy, firing is the thing, and I would like to continue it.

A motion to pass to the next subject was put and carried.

THE PRESIDENT.—The Secretary will please read the next subject.

SECRETARY SINCLAIR.—Furnace.

THE PRESIDENT.—The next subject under discussion is the furnace of the locomotive.

SECRETARY SINCLAIR.—Mr. President, I wish to raise an exception to the statement made in the report respecting the practice of having a certain quantity of fire on the grates. The report favors rather a thick fire in preference to a thin fire, upon the assumption that there are more heat units in a thick fire than in a thin one. I submit that the quantity of heat units depends on the quantity of fire burned—that is, the quantity of fuel consumed.

MR. HICKEY.—Replying to the Secretary, I would say that it is true the committee recommended rather a thicker fire than is carried on some locomotives, They recommend it because they think that in carrying too thin a fire there is always a greater chance of having an irregular temperature in the fire-box. With a very thin fire we all know that air enters at the bottom in large quantities, and instead of adding to the intensity of combustion retards it, for the reason that it reduces the temperature of the fire-box, and not only does that, but it is a very serious injury to the sheets on account of the irregular expansion that it causes. Now, then, if we can increase the fire to a moderate thickness and retain it, it is the opinion of the committee that that is the best plan to adopt under the circumstances. But we do not say that a very thick fire is by any means desirable, in fact we are opposed to it. But we do say, as I stated, that a moderately thick fire is better than an extremely thin one, just for the reasons given.

On motion of Mr. Mackenzie the discussion was closed.

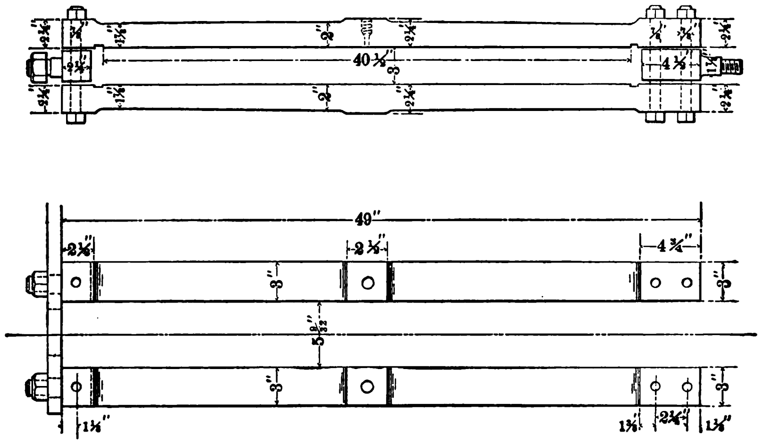
The President.—I will take this occasion to announce Charles Blackwell on the auditing committee in the place of M. N. Forney, who has left Alexandria Bay. I would suggest, if it meets the approval of the members, that a recess of five minutes be taken to enable the members to pay their dues.

REPORT ON CROSS-HEADS AND GUIDES.

A recess of five minutes was then taken, after which the committee on guides, consisting of J. N. Lauder, W. J. Robertson and H. S. Kolseth, submitted its report. The report was read by Mr. Lauder, and is as follows:

The favorite form of crosshead and guide for locomotives in the United States seemed, a few years ago, to have been settled by a process of natural selection. The four-bar form of guide was seen upon nearly every locomotive which would permit of its application. This, no doubt, was due to the fact that for many years there was scarcely any type of locomotive to be seen in this country, with the exception of comparatively few ten-wheelers, but the so-called American type, and this, as well as the ten-wheeler, permitted the four-bar guide to be employed. It probably owes its popularity either to accident or to the fact that it is necessitated by the most obvious form of crosshead. However this may be, it received something of a shock upon the appearance of the mogul and consolidation locomotives, to which it could not be applied without introducing some obviously very bad constructive features. It received a positive set-back when the Pennsylvania Railroad adopted, some six or seven years ago, the two-bar form for all of its classes of locomotives. Since then the well known Laird guide has been somewhat applied to the American type of engine, and its good qualities should commend it to the attention of master mechanics. There are still other forms, one or two of which deserve attention.

It is the purpose of this report to consider the functions of a crosshead and guide, to examine the well known forms, to weigh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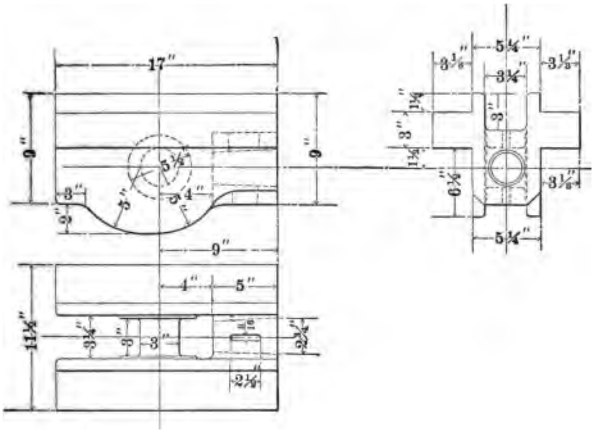
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FIG. 6.

their advantages and disadvantages, and to recommend for adoption that form which fulfills its object most perfectly. The committee has departed from the customary method of sending circulars to each member of the Association, requesting him to state his practice, because nothing, in the judgment of the committee, is to be gained in this way. Every well informed master mechanic is familiar with American practice in these devices, and his attention is invited to them.

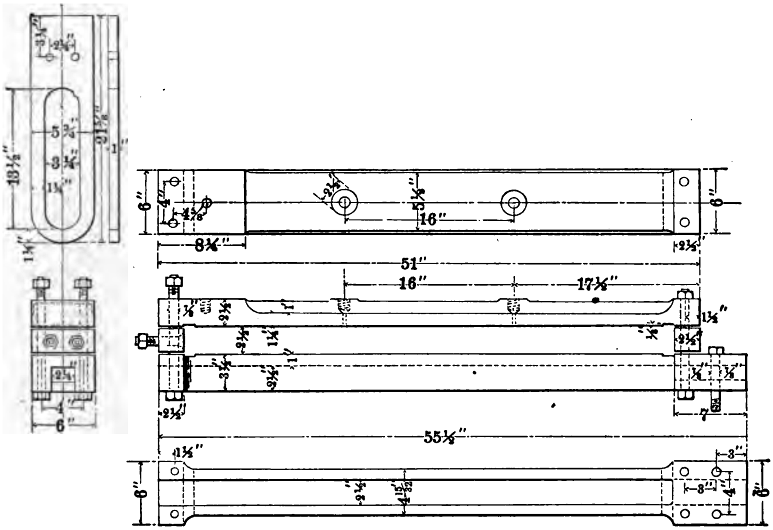
In all, except oscillating and trunk engines, a crosshead is needed to join the piston rod to the connecting rod, and in order to prevent this crosshead from being displaced by an inclined connecting rod, or other cause, it must be held in such a way that it is free to move back and forth in the direction of the length of the piston rod, but, in general, in no other direction. In some modern short connected marine engines, having long bearings, there is nothing to prevent side motion of the crosshead, because there is nothing to cause it, but in a locomotive such construction could not, of course, be employed.

The friction of a sliding block has always been an objection to a crosshead moving in a guide, and consequently much ingenuity was exercised by early engineers, from James Watt downward, in devising jointed systems of links, known by the general name of "parallel motions," for constraining the crosshead to move in a straight line, thus substituting pin friction for flat surface friction. No such device could conveniently be attached to a locomotive, and probably no one has ever made the attempt. They have been very successfully applied to vertical stationary beam engines, but nowadays the tendency seems to be in all countries to return to the sliding crosshead and guide.

THE REQUISITES OF A GOOD CROSSHEAD GUIDE ARE:

1st.—That it shall present sufficient wearing surface to meet the pressure produced by the inclination of the connecting rod, and enough surface to meet side pressure.

2d.—That it shall be strong and so stiff that it cannot spring and cause the ends of the crosshead to press hard upon it, even when the steam is admitted to the cylinder to the latest point of the cut-off.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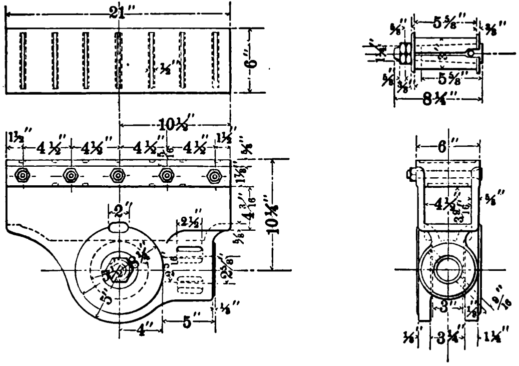
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FIG. 7.

3rd.—That it shall not expose the wearing surfaces to dust and cinders.

4th.—That it can be cheaply made and easily fitted up.

5th.—That it can be easily trued up after service.

6th.—That it shall permit its crosshead to be of a strong, light and cheap form.

7th.—That it, or its crosshead, can have compensation for wear.

8th.—That all parts shall be easily accessible.

THE ORDER OF THE EXAMINATION OF THE GUIDES AND CROSSHEADS WILL BE AS FOLLOWS:

A.—The modern four-bar guide, with upper bars wider than the lower, the latter being of angle form. See figure 6.

B.—The Laird guide and crosshead, as made by the Rhode Island Locomotive Works. See figure 7.

C.—The single bar guide, as made by the Mason Machine Works. See figure 8.

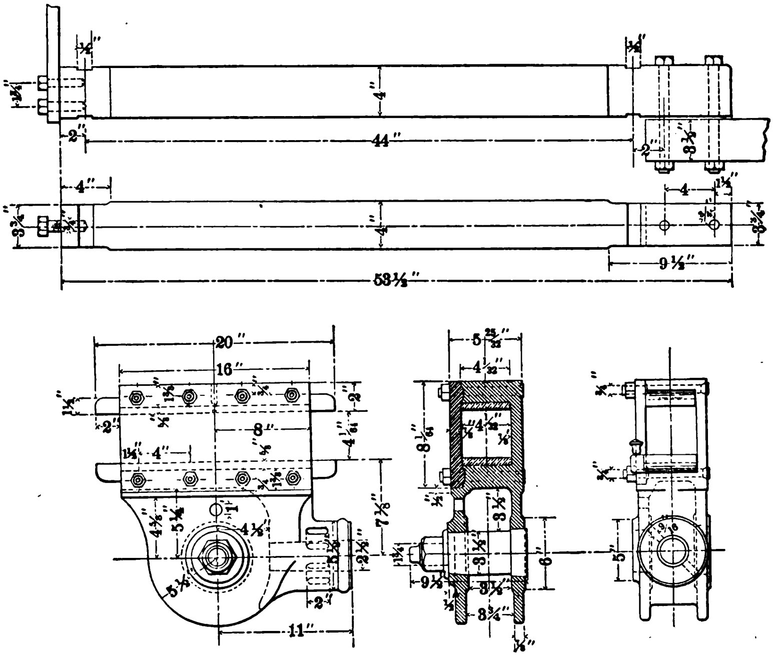
D.—The two-bar guide, as designed and used by the Pennsylvania Railroad. See figure 9.

E.—The Dean patent guide. See figure 10.

THE FOUR-BAR GUIDE.

In considering this familiar form, it is obvious that there is no limit to the amount of surface which can be given to the crosshead to meet pressure and wear in any direction. If the locomotive moves forward, the effect of the inclination of the connecting rod is to cause the crosshead to press upward when propelled by steam, when making either the forward or backward stroke. When the locomotive is running backward with steam on, or in either direction with steam off, the crosshead presses downward. The crosshead and guide should be designed to be most efficient for the engine when running forward, for all classes of engines except switching engines.

This peculiarity of pressure has been kept in view in designing the modern four-bar guide, and the upper bars are made wide, the upturned longitudinal rib of the crosshead being omitted in order to prevent the over-all width of the guides from being excessive. The omission of this rib takes away from the surface which receives side pressure caused by "slap" and twisting of the engine. This is made up by making the lower bar narrow and



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8 1/64"
4 1/32"
3½
3½
6"
1¾
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8¾"
5"

FIG. 8.

with a downward projecting rib, against which the crosshead can press. Thus the first condition can be, and is generally, perfectly fulfilled.

The second condition cannot be so well met, as the bars must be very heavy in order to be strong and stiff. The lower bar does not in any way assist the upper, except when they are tied together by a bolt passing through side lugs on both, a feature adopted by the Manchester Locomotive Works.

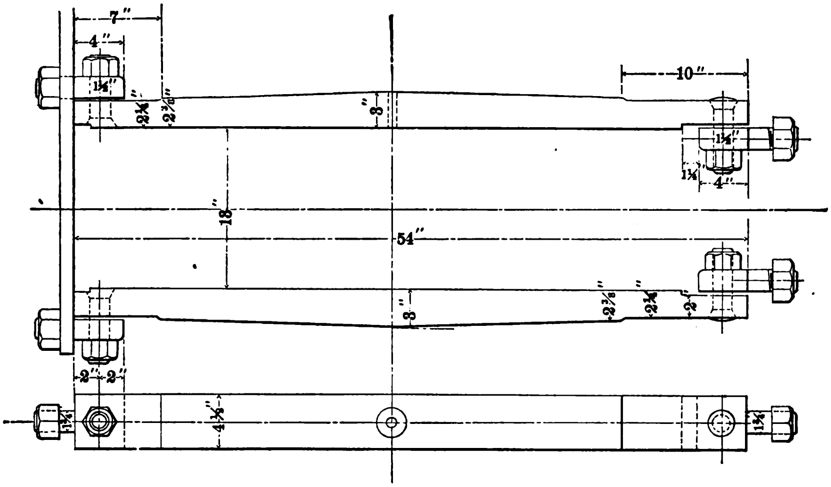
The third condition is very imperfectly fulfilled, the upper bars only protecting the wearing surfaces to some extent. Dust and cinders can find lodging places on the lower bars, and can be ground in between the surfaces which take side wear. The rear engine of two coupled ones will generally receive a shower of cinders upon its guides, and in some parts of the West sand blows on the guides to an alarming extent. It is no uncommon thing to see the lower bars badly cut. This can be to some extent prevented by shielding the guides, and in some instances the upper bars have been changed to one broad one.

The fourth condition is not fulfilled as well as desirable. There are four bars, four blocks and four bolts, and each block is of the nature of a bolt. Considerable skill is necessary in properly fitting these parts so that each wing of the crosshead shall always properly bear upon the bars.

The bars and crosshead can easily be trued up after being worn. The crosshead can be strong, light and cheap, and compensation for wear can be made either by adjusting the bars upon the blocks or by adjusting gibs upon the crosshead, or both.

THE LAIRD GUIDE.

This is a two-bar guide, with both bars above the piston rod, one bar being wider than and immediately above the other. The bars can be of any width, and the upper bar can be, and generally is, made wider than the lower, thus giving the needed extra surface for upward pressure. The upper bar usually takes all of the upward pressure, but the Mason Machine Works have made Laird guides with the crosshead pressing upward upon both bars, but probably the nice fitting needed to make both wearing surfaces effective, would prevent most builders from following this prac-


7"
4"
1⅛"
2¼"
2⅜"
3"
10"
1⅛"
1⅛
4"
18"
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2"
3"
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2"
1⅞
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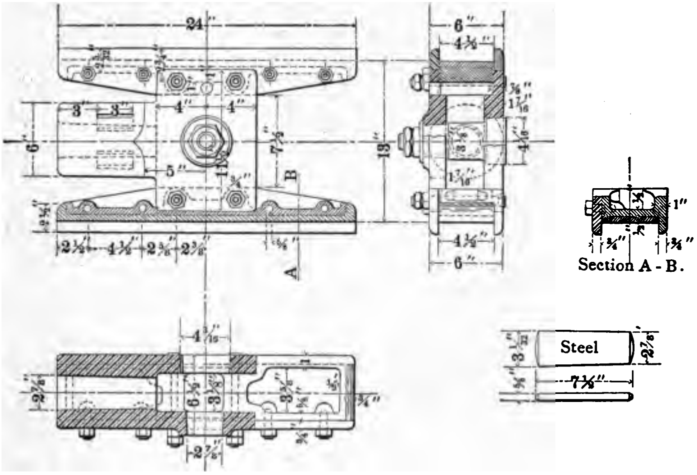
24"
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4½"
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18"
5"
B
A
2½"
4½"
2⅜"
2⅜"
⅜"
1 7/16"
4½"
6"
1"
¾"
¾"
Section A-B.
4 3/16"
2⅞"
2⅞"
Steel
7⅛"

Fig. 9.

tice. The lower bar passes through the upper part of the crosshead, and takes all of the downward and the side pressures.

There is no limit to the width of this guide for an American or ten-wheel locomotive, and for a mogul or consolidation engine the available width of space is fully utilized to secure a wide upper bar.

By employing sufficient material the bars can be made as stiff as desirable, but no assistance of one bar can be secured from the other, and in this respect the design is unscientific and wasteful of material.

The wearing surfaces are nearly as badly exposed to cinders and dust as those of the four-bar form.

In cheapness the guide is preferable to the four-bar form, as there are half as many bars and half as many blocks, and the labor of fitting is considerably less.

It can be easily trued up after being worn.

The crosshead can be strong, light and durable, but it is rather expensive, as it consists of two pieces and five ream bolts, all of which require considerable fitting to make a good job.

There is no difficulty in providing compensation for wear, either on the bars or crosshead.

THE SINGLE BAR GUIDE.

The bar is above the piston rod.

This form of guide can be of any width where there is unlimited space, but as the crosshead surrounds the bar the available space on a mogul or consolidation engine cannot be used advantageously. The surfaces for downward and upward pressure are equal, and there is ample surface to meet side pressure.

By employing sufficient material the guide can be made stiff.

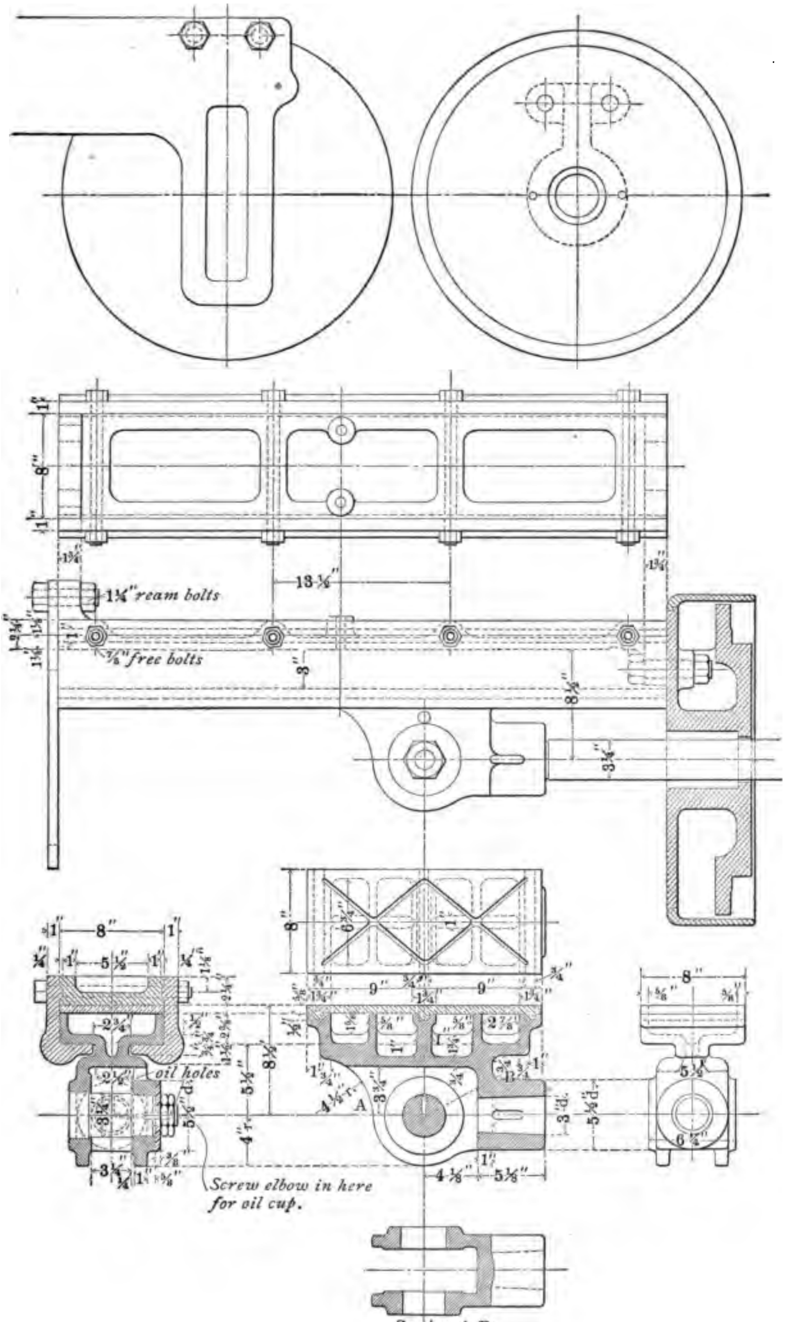
All of the surfaces are exposed to dust and cinders.

This is the cheapest guide of all forms, but it can compensate for wear in only one direction, that in the other being taken up by a gib on the crosshead.

The crosshead is almost identical with the Laird crosshead, and calls for the same remarks.

THE TWO-BAR GUIDE.

One bar is above the piston rod, and the other below.



Section A B.

FIG. 10.

guide thus resembles a box girder with upper and lower flanges and webs connecting them. It is thus the most scientific in the use of material of all the guides. The angle pieces are let into the upper bar and secured to it by four free bolts, end motion of the angle pieces being prevented by the cylinder head at one end, and the yoke at the other, against which they abut.

The depth of the guide, together with its girder form, cause it to fill the condition of stiffness more perfectly than any other form.

The third condition is also more perfectly fulfilled than by any other form, because the wearing surfaces are wholly within the girder or guide, and entirely out of the path of particles of dust and cinders. All surfaces for upward, downward and side wear are consequently fully lubricated by clean oil, and cutting can never occur as long as oil is applied. In cost it is considered to be cheaper than the four-bar form, as it consists of three pieces against eight in the four-bar form. These three pieces can be fitted together, and then all three squared off in a lathe or planer and put in position as one piece.

Its width over all is about equal to that of the four-bar form, and for that reason it is not likely to be used on any locomotive which has a driving wheel between the guide and the frame.

In comparison with the Laird guide, it is probably more expensive in machine work, but less so in fitting.

It can easily be trued up after being worn.

The crosshead is of a simple, light, cheap and durable form. It consists of one piece without the gib.

As thus far designed there is no way to compensate for wear by adjusting the guide, and a gib is therefore used for that purpose.

Your committee is unable to see that it is material whether compensation for wear is made by adjusting the guides or the gibs. If the guides are adjustable they must rest on blocks, which are bolted to the cylinder head and yoke. In this case the gibs can be omitted. The cost of the blocks will about equal the cost of the gibs. Gibs, of course, are always useful in preventing wear of the crosshead body.

Your committee, in summing up the advantages of the differ-

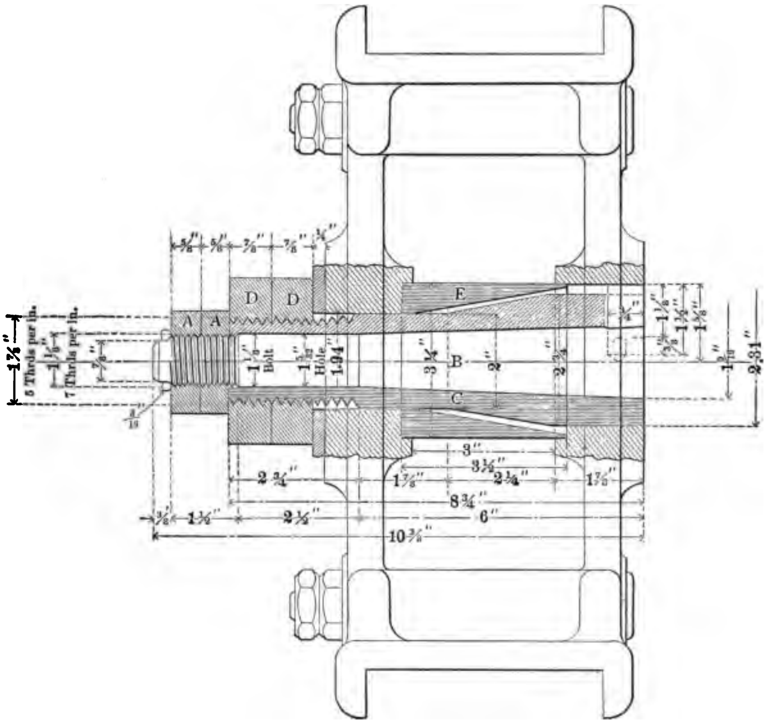

5/8″
5/8″
7/8″
7/8″
1/4″
A
A
D
D
E
B
C
1 7/8″
5 Thrds per in.
7 Thrds per in.
1 1/8″
7/8″
3/16″
1 1/8″ Bolt
1 5/32″ Hole
1.94″
3 1/4″
2″
2 3/4″
1/4″
1 1/8″
1 1/2″
1 5/8″
3/8″
1 3/16″
2.31″
3″
3 1/2″
2 3/4″
1 7/8″
2 1/4″
1 7/8″
8 3/4″
3/8″
1 1/2″
2 1/2″
6″
10 3/8″

FIG. 12.

ent forms of guide and crosshead and recommending them for adoption, is of the opinion that for the eight-wheel American type and the ten-wheel locomotive the Dean guide and crosshead fulfill the conditions and perform the functions of perfect devices to a greater degree than any other form. On locomotives, such as moguls, consolidations and decapods, where the width of the Dean guide renders it difficult to secure clearance for the forward crank pin, the Laird guide is recommended. It is so constructed as to use all of available space for width of the upper bar, is more nearly dust and cinder proof than any of the open forms, is fully as cheap as any form, and, in common with the Dean, is above the piston rod and leaves the stuffing box accessible.

For switching engines, which run as much in one direction as in the other, from a theoretical standpoint the single bar, or two-bar form, would be best adapted, but for the sake of having the smallest variety of patterns in service, and having the parts as free from dust and cinders as possible, the Laird is recommended for this class of engine.

There are a variety of ways by means of which the crosshead box of the connecting rod can be efficiently adjusted, but with the crosshead for the two-bar guide, the small space about the end of the connecting rod has generally forced the adoption of a transverse key, of necessarily limited range of adjustment. To overcome this objection, Mr. J. B. Henney, of the N. Y. & N. E. railroad, has used an "expansible crosshead pin," shown in figures 11 and 12, which consists of a central tapered pin, which is surrounded by a hollow pin, split lengthwise on one side. The taper of the central pin and of the inside of the hollow pin is very slight. Both pins pass entirely through the crosshead, and each has nuts on one end for securing it. The outside of the hollow pin is steeply tapered, and fits the tapered inside of a sleeve which surrounds it. This sleeve is divided into halves vertically, in order to allow them to separate horizontally. These halves fit the connecting rod box, and are square on both ends. The square parts fit into grooves in the crosshead, which prevent them from turning. When it is desired to take up lost motion, the central pin is slackened up and driven slightly back, after which the hollow pin is drawn forward by means of the nuts on its end. This expands the outside sleeve, and thus takes up the lost motion. After this the nuts are all set up, and the whole system becomes solid.

Mr. Henney's claims for this arrangement of crosshead and pin are as follows:

"1st.—A good working crosshead complete with pin.

"2nd.—Less and longer wear of brasses.

"3rd.—Solid end main rod of simple construction.

"4th.—Length of main rod more nearly preserved.

"5th.—Less labor in lining and closing brasses."

The pin had been in service eighteen months up to Oct. 1, 1887. In practice about $\frac{1}{6}$ of a turn per month is given to the nuts on the hollow bolt or sleeve, which expands the bushings $\frac{1}{100}$ of an inch. As there is a possible expansion of $\frac{31}{100}$ of an inch, it is considered that the engine will run thirty-one months before it will be necessary to take down the rod for shimming the brasses.

Mr. Henney expresses himself as perfectly satisfied with the pin. It is evident, however, that the tapered hollow pin can fit the expansible sleeve but once, either at the beginning or end of its path. The drawing indicated that there is no attempt at making it fit at any time, the only requisite being that there shall be one line of contact between the hollow pin and each half of the expansible sleeve, both lines of contact lying in a horizontal plane passing through the axis of the pin. This would permit the sleeve to roll on the hollow pin, if it were not prevented by the square ends.

It will be seen that the action of this means of adjustment is to cause boxes, which wear out of the circular form, to work against a pin, which is thrown out of the circular form, and the more the adjustment is made the greater the deviation is from the circular to the oblong form. It is evident that the box must wear much faster than the pin, and if the pin is solid it will be practically round for many years, and the beauty of moving the boxes is that when they are adjusted they are brought up to a circular pin, against which they can turn without difficulty, even if they are not themselves truly circular.

This system of pins and bushings must be very expensive, but if the end justifies the means, there is no need of complaint.

In regard to the material for crossheads and guides, your committee recommends cast iron for guides, and steel castings for the crossheads. If, however, a true open hearth steel casting is used it must be protected by gibs. Eureka steel castings will run without gibs, and so, probably, will any other de-carbonized cast iron. For gibs your committee recommends cast iron.

There can be nothing better for rubbing surfaces than cast iron, if well lubricated. If it is exposed to dust and cinders, it would be well to use strips of Babbitt metal, but with the Dean crosshead, which always runs in clean oil, this is unnecessary. Phospor bronze gives admirable results for crosshead gibs. Whatever form or material is used for crossheads and gibs, the rubbing parts should always be well scored with grooves for retaining oil to supply to the moving parts, as they journey back and forth.

J. N. Lauder,
W. J. Robertson, } *Committee.*
H. S. Kolseth,

DISCUSSION ON CROSSHEADS AND GUIDES.

Mr. Mackenzie.—I move that the report be received.

The motion was carried.

The President.—The report is now open for discussion.

Secretary Sinclair.—I might explain, gentlemen, that the illustrations of this report are on the side wall there, and in drawing your attention to them I wish to testify to their excellence for reproduction in the form of wood cuts. A great many reports come in with blue prints attached that are necessarily reproduced for making the report clear, and there seems to be no understanding among many members who send in reports about what is needed in that respect. They will send in most elaborate blue prints in the worst shape for illustration that possibly could be imagined, and never appear to understand that these things have to be reduced and put in shape for publishing in the annual report. I wish just to direct attention to this matter, for it is very important.

Mr. J. N. Lauder, Old Colony.—Having made the report, I suppose it is incumbent upon me to open the discussion. In considering this matter of guides and crossheads, the committee departed from the usual method that has been taken by committees of this Association, which is to issue circulars of inquiry in regard to the subject to the members, and from their replies and other sources compile a report. I think I am on record, and if I am not I want to put myself on record against what has grown to be the usual method of getting information and making reports to this Association on questions like guides and crossheads. Of course, in making a report where statistics are to be used, and where it is necessary to give figures to make a report of any value, it would be necessary to get information from circulars and get statistics from the various members; but where the question is a purely mechanical one I think that it is very much better and more to our credit, and more proper for this Association, to have a committee put in a little work and make a report which will not be merely a rehash of the replies received from a few of the members of the Association. It often occurs that the very ablest men, and the men who are best qualified to answer these questions, neglect to do so. I think that is apt to be the case, and the result is that reports sent here sometimes are a laughing stock all through similar organizations as being simply a rehash of the opinions of some portion of the members of the Association. Now, I think it is the duty of every member of the committee, especially of the chairman of the committee, who is supposed to make the report, and in fact always does, to give the question sufficient time and consideration and labor, and bring in a report that will contain facts and make definite recommendations when such recommendations would be proper; and your committee have acted upon this line of thought, and have produced this report on guides and crossheads. I do not suppose it is necessary for this Association to discuss well known forms of guides and crossheads. The committee have discussed them quite elaborately, taking up each leading form of guide, and have drawn their conclusions, I believe, from facts. The great difficulty to-day with all the well known forms of guides and crossheads is their facility for catching dust and cinders and everything of that nature, consequently when the engine comes in to have her tires turned the guides have to be lined up. Now, to take the lost motion out of the crosshead and put the guides in line and make a good job, means quite a number of days' labor of a good man. A roundhouse helper cannot do that. You have got to have a good mechanic. Anything that we can do in the way of first construction to eliminate the necessity of these frequent repairs to guides and crossheads, I think we should do. Realizing that fact several years ago, I applied the Dean crosshead, which is given a little space in the report, to a locomotive, and have been carefully watching its performance. That locomotive was put into service five years ago last month, and has been in continuous service since—a 17x24 American locomotive. It has been in continuous hard service in that time, as hard service as any locomotive gets, and so far there has been nothing—when I say nothing I mean nothing—done to that guide and crosshead, absolutely nothing; and while the engine is running on a road that I have nothing to do with at present, I took pains to go and inspect it myself, so that I would know what I was talking about, and in my opinion it will run five years more without being touched. The performance of those crossheads and guides on that locomotive led me to adopt that form of guide and crosshead for eight-wheel engines, and I am putting them on to everything that we buy or build, and I think I am working in the right direction. It does seem to me that if all the members of this Association knew what I know about that form of guide and crosshead, notwithstanding the fact that it was patented, they would give it careful consideration, and, I am sure, would make experiments with it. I ought perhaps to have come here with some data that I have not got, and that is the relative cost of these different kinds of guides and crossheads; but you are all as familiar with the four kinds, and able to judge of the comparative cost of the different appliances. I can only say this, that I am certain that in building new locomotives, after you get your pattern and get what special tools are necessary, which are very few, that a guide and crosshead of the Dean style can be fitted up and applied to a locomotive for less money than either of the other designs. mainly because it is all machine work. The two vertical bars we build on to the horizontal bar are built with a tongue to fit into a groove on the edge of the main bar, and endwise between the bolt on the back end of the cylinder head and the yoke at the other end, so that there is no possibility of any end movement. Holes are bored through the top bar, and also through the upper edge of the vertical bars, and simply cleaned out with a drill, and rough bolts put in if you like. As a matter of fact, we turn the bolts to a loose fit. You have then got a guide with a large bearing surface on top, on the bottom and sidewise, and a guide that runs almost absolutely clean, and with reasonable lubrication I would be willing to stake my reputation that they will run for years without the slightest cutting or tendency to cut and with very little wear. I can only say that after five years service the first set that I ever applied is to-day in good shape and needs no repairs.

MR. JOHANN.—I move that the subject be closed.

MR. HICKEY.—I find that the committee recommend cast iron guides for locomotives and say nothing of any other. Now for years we have been using cast iron guides, case hardened guides and steel guides. With the cast iron and the case hardened guide we use brass gibs or brass bearings on the crosshead. On locomotives having cylinders 17x24 inches we have crossheads 16 inches long, top bearings 4 inches wide, bottom bearings 3 inches wide. The lateral thrust of the crosshead is taken up entirely by the bottom guide, which has a depth of bearing of 3 inches. The cast iron guides constructed as stated, render us a mileage of 10,000 to 1-64 of an inch wear; while the case hardened guides give us a mileage of 65,000 to 75,000 miles to the same unit of wear. The cost of the cast iron guides prepared, not including putting up, is $25, while the cost of the case hardened guides is $105. The engines on which comparisons are made are the regular American type of engine, four wheels connected, having a length of main rod of 8 feet. The case hardened guides have much less friction and run with less oil, and on the whole are much more satisfactory.

MR. J. M. BOON, West Shore.—Looking over the different kinds of guides that came under my observation, I have settled down to what is known as the Laird guide for heavy freight engines, and what is known as the Pennsylvania style of guide for passenger engines. The Laird guide, the top guide being divided from the bottom, gives a good bearing, as the committee state. One great advantage is that it admits of a larger truck wheel. In all our passenger equipment, as a general thing, the engine truck wheels are too small. Running at high speed, the increased velocity of the smaller wheels makes a great deal of difference. All over the country "hot engine trucks" is almost a universal complaint. The open guide known among engineers as the "alligator" guide leaves ample space to get in a large wheel. With a 5½-foot wheel, we can run a 33-inch truck wheel, giving ample room on a road with very sharp curves. It also admits of ample bearing surface. You can get almost any width of surface you want, and it is a strong guide in every way. The only objection that can be urged against it is that in case the engine should run off a switch, the truck may slew around and break a crosshead shoe. They wear well. The greatest expense is the crosshead, which is made of steel. The shoes can be made in the course of an hour. Most of the wear can be provided for by putting gibs over or letting the guides together. Letting the guides together is a poor plan. It can be done by facing the blocks off or cutting the end of the guide, or by making an arrangement for putting the gib on the crosshead. Our general plan is to put liners. With this lost motion, if you let it run too long and it gets too great, there is danger of breaking the shoe. My experience with this form of guide in hard service, rough and smooth track, has resulted in my forming the opinion that it is the best in use to-day for passenger service.

MR. LAUDER.—Before the question is put I would like to read a letter from Mr. Henney with reference to the performance of an expansible crosshead, which has been mentioned in the report. This pin, I think, possesses some features that would bear a little investigation, mainly from the fact that you can put up a solid end connecting rod with a bushing, if you like, just a plain round brass bushing, which will cheapen the rod very much. It dispenses with the cutting the key-ways and bolts and holes, and makes a very complete, safe job. I wrote to Mr. Henney with reference to the actual performance of this pin on his road, and here is his reply; it is short:

"In reference to wear of expansible crosshead pin, I will give you below the time and mileage of the three engines.

"Engine 32 left shop March, 1886, and has made 74,977 miles to date without having front end of main rods taken down or removed from the crosshead.

"Engine 55 left shop in January, 1887, has made 32,755 miles without having main rods or side rods taken down.

"Engine 77 left shop in September, 1886, and under same conditions has made 42,999 miles. Not having seen these pins, as they have been intact, cannot tell the conditions from the work."

This letter shows that pin will give a good result in actual practice. I cannot say whether there is any patent on it or not. I think it was designed by Mr. Henney's draftsman.

The motion to close the discussion was then put and carried.

TO PROMOTE ADOPTION OF STANDARDS.

THE PRESIDENT.—It is now the hour for the introduction of miscellaneous subjects. Any member who has a question to propose for discussion will please hand it in to the Secretary.

Secretary Sinclair.—The following question has been handed in:

"What is the best course to pursue to induce members to adopt standards?"

The question is submitted by Mr. Sprague.

Mr. Sprague.—I was led to think of this matter from the remarks made yesterday about the question of standard tire that was adopted here a year or two ago, and we agreed on it apparently as being the proper thing to do; but from what I have learned since, it seems that the action concerning it ended there with our decision to adopt it. The adoption was further ahead, as I understand it. I simply raise this question to see if some means cannot be adopted by which the members will feel under obligation to do something toward carrying out standards which they decide as being proper and correct here. I do not know of any form to put it in, but the thing occurred to me whether it would not be a good idea to authorize the Secretary to issue a circular to all the members, asking them what they are doing and what they propose to do with reference to adopting such standards as we decide on here, and get their answer. I do not know whether that form is practicable or not, but it has seemed to me that some members could be induced to take action as regards adopting a standard, rather than say here before the Convention that while they approved of it they are not paying any attention to it.

Mr. Lauder.—I think the gentleman is a little severe on us in regard to the adoption of a standard size of tires—wheel centres. I think that is coming along fully as fast as any of us have reason to expect. We cannot expect that a large road with from two to five or six or 800 engines is going, as soon as we adopt a standard, to change all their construction in a year, simply to gratify our love of getting down to a standard. These roads have all got a standard of their own, especially in the diameter of tires, and they are loath to give them up; and while there is no interchange of engines between their road and other roads, they prefer to stick to their own standard. But it has come to pass that some of the roads that are situated like this I have described have adopted on their new constructions the master mechanics' standard size of wheel centre. That shows we are all willing to come into it. I think our worthy President, as a locomotive builder, would probably tell us that he has engines ordered very frequently where it is specified that the wheel centres shall be of the master mechanics' standard size.

Mr. Mackenzie.—And very frequently not.

Mr. Lauder.—Very frequently not. Of course, in this matter of standards I fully agree that we ought to get all matters like tires, and perhaps other things, down to a standard, but the necessity for coming to a standard does not exist so largely in the locomotive department as where there is interchange between the different roads.

Mr. Sprague.—I fully concur with Mr. Lauder, that it would be unreasonable to expect that people would sacrifice economy in adopting standards at once. But if these men could answer that in new work, on any point that they can, they are adopting standards, we should be sure that we were getting at it. You must look farther ahead, and remember that you will be able to carry a smaller stock of tires, you will be able to get your material cheaper and more promptly if you get down to a standard size of tire. With standard sizes generally adopted, the manufacturer of tires would not hesitate to carry tires in stock. If you want a set in a hurry you can get them already made, but if you have so many different standards they cannot do it. It is not so much the question with me about the necessity of people adopting standards at the expense of economy as to know that they are working in that direction, and I do not know of any other way to get at it than to get them on record whether they are adopting them as fast as economy will allow them to. The answer to this query would enable us to tell whether they are trying to work to a standard. or whether they are entirely indifferent to it.

THE PRESIDENT.—I would say, for the information of the Convention, that the Brooks Locomotive Works ordered a set of standard tire gauges immediately on the receipt of the committee's circular, and they are being used entirely in all our new works, but we do, as the gentleman has suggested, frequently receive orders for wheel centres varying from master mechanics' standard. Not long ago we received some wheels from a road not of our own build, and we found, on applying our gauges, that those tires had evidently been put on to the master mechanics' standard, and it is being quite universally adopted, and yet there are others who do not seem willing to make the change.

Is there any farther discussion on the subject? If not, a motion to close it will be in order.

On motion, the discussion was closed.

THE PRESIDENT.—If there are no other questions to be handed in for discussion, we will resume the regular order of business, which is a report from the committee on Springs and Equalizing Gear.

Secretary Sinclair read this report, which is as follows:

REPORT ON SPRINGS AND EQUALIZERS.

Your committee have no excuse for the meager report they are compelled to make, except that of a want of interest on the part of the members of the Association in answering the circular which was duly sent out with a special request for as full a report as possible. We have received answers from but 12 roads, the substance of which is as follows:

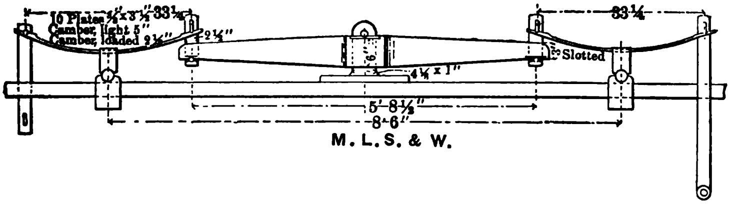
First Question.—What size of steel do you consider gives the best results in locomotive driver and engine truck springs? It is assumed that crucible cast steel is used, but if not, please state what kind of steel you recommend? One spring maker and the Ohio, Indiana & Western Railway prefer 3¼x⅜-in. The Chicago, Burlington & Quincy Railroad, Savannah, Florida & Western Ry., Milwaukee, Lake Shore & Western Ry., Central Vermont R. R., Cincinnati, New Orleans & Texas Pacific Ry., Newport News & Mississippi Valley Co., Terro Carvil de la Bahia (Cuba), Chicago, St. Louis & Pittsburgh R., Richmond & Danville R., and N. Y. C. &. St. L. R. 3½x⅜ in. The Grand Trunk Ry. of Canada 3½x½ for driving and 4x½ in. for engine truck.

Second Question.—What length of spring, from center to center of hangers, gives the best results for both driving and engine truck springs? The O., I. & W. Ry. and C., B. & Q. R. report 32 in.; M., L. S. & W. Ry., 33¼ in.; N. N. & M. V Co., 35 in.; R. & D. R., 35 to 36 in.; E. V. R., C. N. O. & T. P. Ry. and C., St. L. & P. R., 36 in.; F. C. de la B., 36½ in.; N. Y. C. & St. L. R., 38 in.; S. F. & W. Ry. 41 in. and G. T. Ry., 39 to 48 in.

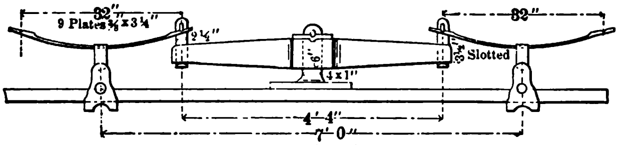
Third Question.—How many plates should be in each driving spring, to carry an 8-wheel passenger engine, with about 56,000 lbs. on the driving wheels, or about 14,000 lbs. on each driver? The O., I. & W. Ry. answer 9 plates, M., L. S. & W. Ry., C., N. O. & T. P. Ry., and F. C. de la B., 10 plates; C., B. & Q. R., 11 plates; C., St. L. & P. R., N. Y. C. & St. R. and G. T. R, 12 plates; R. & D. R. R., 14 to 15 plates; S. F. & W. Ry. and C. V. R., 15 plates.

Fourth Question.—How many plates for engine truck springs, with about 34,000 lbs. on truck wheels? The S. F. & W. Ry. use 12 plates; C., B. & Q. R., 10 plates 11x⅜ in.; C., N. O. & T. P. Ry. and G. T. Ry., 13 plates; M., L. S. & W. Ry. and F. C. de la B., 14 plates; C. V. R. and N. Y. C. & St. L.; 15 plates. One spring maker 15 plates 4x⅜ in. and 16 plates 3½x⅜ in.; N. N. & M. V. Co. and C., St. L. & P. R., 16 plates; R. & D. R., 16 to 18 plates.

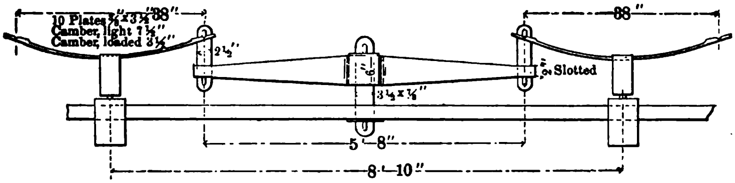
Fifth Question.—How much camber, or set, should such driving and truck springs have when free? How much when loaded with the above weights? The C., B. & Q. R. answer ¾ to 1 in. for driving loaded and 1 to 1¼ in. for truck loaded. One spring maker, R. & D. R. R., F. C. de la B., and N. Y. C. & St. L. R., 2 in. for driving and truck springs loaded; C., St. L. & P. R., 2¼ in. for driving and 2 in. for truck loaded; M., L. S. & W. Ry., 2½ in for driving and truck loaded; S. F. &. W. Ry., 2¾ in. for



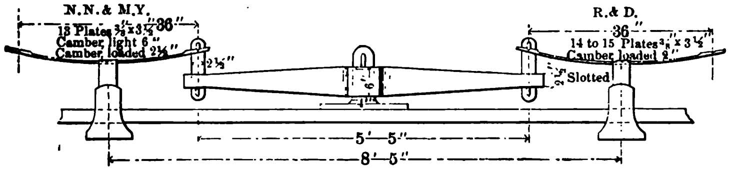
M. L. S. & W.



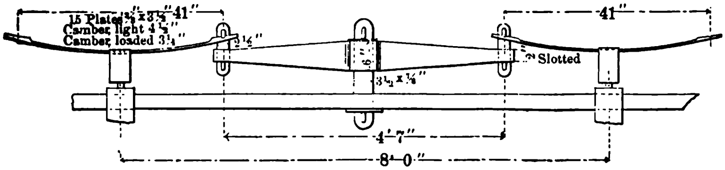
I. B. & W.



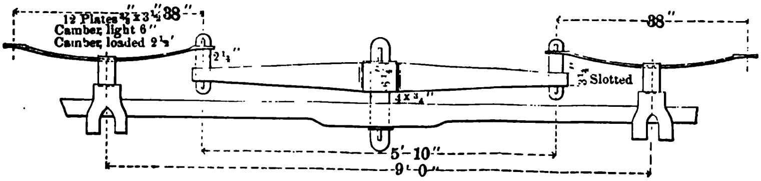
C. N. O. & T. P.



R. & D.
and
N. N. & M. V.



S. F. & W.



N. Y. C. & ST. L.

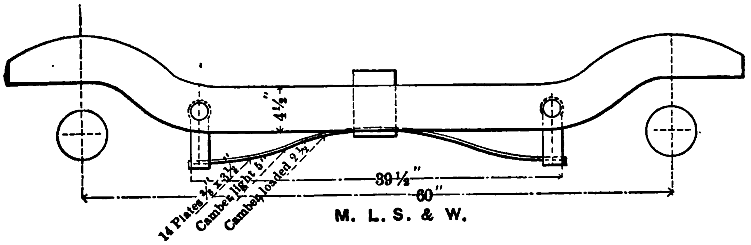
FIG. 13.

driving and truck loaded; C. V. R., 4 in. for driving and truck loaded, and C., N. O. &. T. P. Ry. 7½ in. over all for driving and 6¾ in. over all for truck loaded.

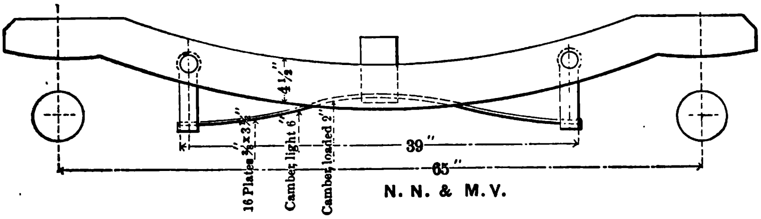
Sixth Question.—Do you recommend the same size of steel, and distance between hangers, for all classes of engines, and regulate the capacity by the number of plates, or do you have different sizes of steel to change the capacity? If the latter, please state the advantage of that plan. One spring maker and all the railroads mentioned above recommend the same size of steel and distance between hangers for all classes of engines, and regulate the capacity by the number of plates.

Seventh Question.—Please state your preference for the attachment of the spring hanger—slot or stirrup—and give your reasons for the preference. One spring maker recommends slot and stirrup. C., B. & Q. R. prefers the slot, because the width is generally too limited to permit a stirrup without cutting away the sides of the spring, and their method of slotting has never caused any serious trouble. F. C. de la B. prefers the slot; handier to connect and cheaper to make; looks better and lasts just as long; use the stirrup on truck springs. M., L. S. & W. Ry. prefer the slot; it is cheaper and permits of better adjustment. C. V. R. uses the slot; easier taken care of and more convenient to replace in case of breakage. C., N. O. & T. P. Ry. prefers the slot; easier made; keeps clear of the fire-box, thereby saving wear to the latter and itself. N. N. & M. Co. prefer the slot for driving springs and the stirrup for truck springs. R. & D. R. prefers the slot; the bearing is much more uniform and less liable to fracture the plate; it also lessens rigidity and aids elasticity. C., St. L. & P. R. and G. T. Ry. prefer the slot in both driving and truck springs; it gives more room and does not crowd the fire-box; is cheaper and more easily adjusted and more accessible in case of breakage.

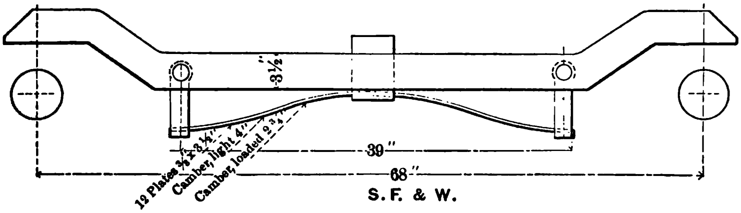
Eighth Question.—What is your method of applying bands? What size of iron do you use, and is there any advantage in making the bands wider at the bottom than at the top? The above roads answer that the bands are placed on hot and upset with sledge and flatter; bands are made by hand 3⅛x½ in. for engine truck springs. The C., B. & Q. R. says there would be a disadvantage in using bands that are wider at bottom than at top, as



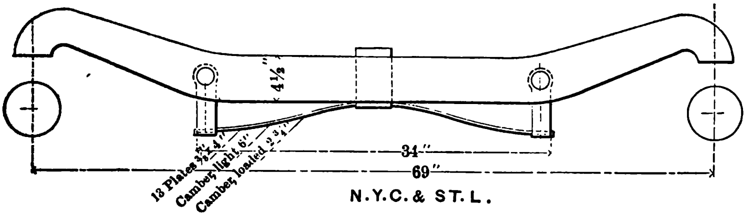
M. L. S. & W.



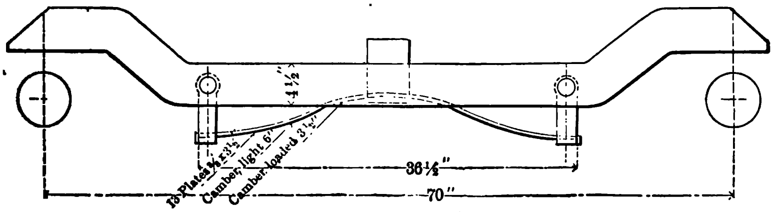
N. N. & M. V.



S. F. & W.



N. Y. C. & ST. L.



C. N. O. & T. P.

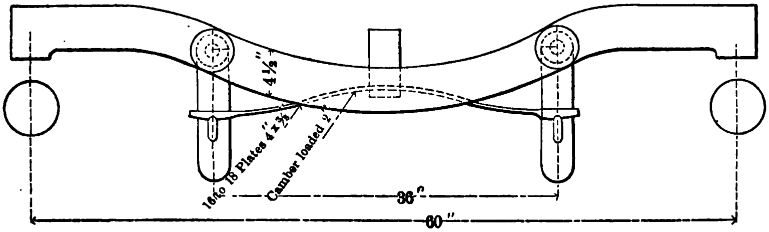
FIG. 14.

far as the spring is concerned, for we would lose just so much of the flexibility of the lower leaves. C. V. R. uses 4x¾ in. iron for bands. A. & D. R. claims the best results have been obtained from bands 4x½ on sides and top and 1 in. thick on bottom, a slight advantage being gained by making bands wider at the bottom than at the top; the tendency to tilt or turn to or from the fire-box is lessened by the broad bottom, while the elasticity of the spring is not reduced, if the band is properly proportioned; but does not consider the advantage gained sufficient to cover the additional expense of making bands. C., St. L. & P. R. make and prefer bands for driving springs 3½x½ in. on top and sides and ¾ in. thick on bottom, and for truck 4x½ in. on sides and bottom and ¾ in. thick on top. In this case the truck springs are reversed from the driving springs. G. T. Ry. uses 2½x⅜ in. iron, and thinks there is no advantage in having bands wider at top or bottom, as it would hinder the natural movement of the spring plates.

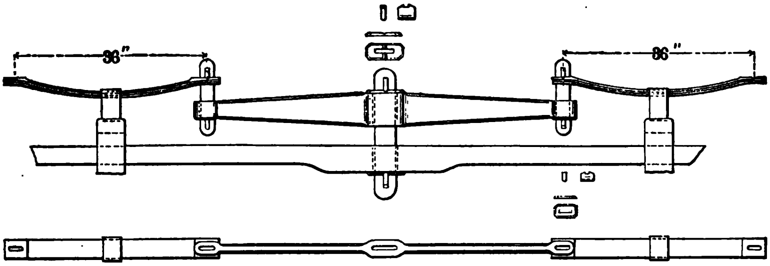
Mr. Porter, of the Cincinnati, Sandusky & Cleveland R., reports as follows: For the last three years I have made my spring bands on forward truck springs 3¾ in. on bottom and 2 in. on top by ¾ in. thick, and spring bands on driver 3½ in. on bottom and 2 in. on top by ⅝ in. thick. I have had good success with my springs.

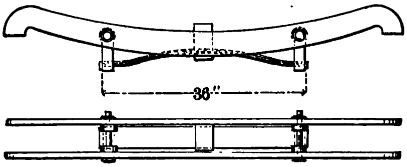
Ninth Question.—Have you had any experience in the use of bandless springs? C., N. O. & T. P. Ry. answer yes, but not satisfactory. M., L. S. & W. Ry. have tried bandless springs, but have not had them long enough to decide on their merits.

Tenth Question.—What is your practice in regard to equalizers for driving springs? Do you recommend a solid bar or one slotted for a post? Please send sketch or blue print showing equalizers and attachment both in the centre and to springs. C. E. R. uses solid bar with slotted ends to receive hangers; the centre has a bearing on a steel pin 1⅓ in diam., the whole contained within a clasp which is bolted to the main frame. All the other roads report using equalizers slotted for a post, upon which it bears by means of a steel key through the post, the bearing surface on equalizers being faced with steel. C., St. L. & P. R. has several engines with frame slotted to allow the post to pass


4½"
16 to 18 Plates 4" x ⅜"
Camber loaded ½"
36"
60"

R. & D.


36"
36"


36"

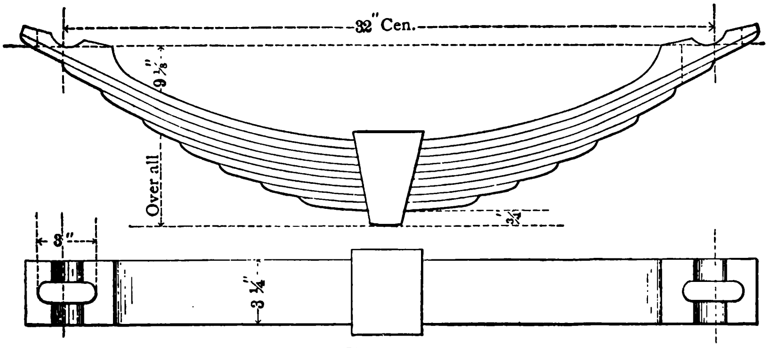

32" Cen.
9⅞"
Over all
¾"
3"
3¼

FIG. 15.

through, and prefer this practice as less liable to give trouble from breakage of bolts. The post is slotted for a steel gib, and steel dies are fitted on the top of the equalizers for the gib to work on.

Eleventh Question.—What is your practice in regard to engine truck equalizer? Please send sketch or blue print of equalizer and attachment to truck box and spring. All the above roads say their engine truck equalizers are composed of two parts from ½ to ⅞ in. thick by 4 to 4½ in. wide, and connected as shown in cuts.

Twelfth Question.—Please send sketch or blue print of what you would recommend as the best form of equalizer and attachment for a mogul or two-wheel truck. We have received but two replies, and drawings from one only.

The committee respectfully submit the following recommendations under the several questions:

First Question.—3½x⅜ in. crucible cast steel.

Second Question.—36 in. from centre to centre for both driving and truck springs.

Third Question.—12 plates, with 14,000 lbs. on each driver.

Fourth Question.—16 plate, with 34,000 lbs. truck wheels.

Fifth Question.—4½ in. free and 2 in. loaded.

Sixth Question.—We would insist on the same size of steel for all classes of engines, whenever it is possible, and regulate the capacity by the number of plates.

Seventh Question.—The slot, because the width is generally too limited to permit using a stirrup without cutting away the sides of the spring.

Eighth Question.—Placing the bands on hot and upsetting with machinery or sledge and flatter and cooling rapidly. Prefer iron 2½x½ in. on top and sides and ¾ in. thick on bottom for both driving and truck springs, and would not recommend making bands wider at bottom than at top.

Ninth Question.—Have not had any experience with bandless springs, nor have we the experience of others, and have no recommendations to make.

Tenth Question.—A solid bar with slotted ends and centre for hangers and post, a steel gib through the hangers and post, also the frame slotted to allow the post to pass through, with steel gib on under side of frame. Prefer this as cheaper and less liable to give trouble from breakage of bolts.

Eleventh Question.—Two bars 4½x¾ in., as per fig. 3, plate 2.

Twelfth Question.—We have had but two replies, and the committee make no report or recommendation.

An improvement in engine and tender springs has been brought to the attention of your committee, and one which we think is worthy of your consideration, as it may prove an important factor in the improvement of this class of springs in the future; we refer to the "V" shaped band, shown in figure 4, plate 15, invented by George W. Morris, of the A. French Spring Company, who manufacture this style of spring, having put some in service. We understand that the claims are that the bands are wider next to the main plate and narrower next to the short plates. It is an established fact that the inclination of the main plates is to leave the outer ends of the band in attaining towards a straight line, thus relieving the pressure of the band on the main plate, while the short plates are forced against the bands, rendering them liable to breakage. With less width of band on the short plates, pressure is thus decreased, an easier and increased motion is imparted, and liability of breakage consequently reduced. The cost is not increased nor the carrying capacity reduced, and if Mr. Morris' theory is correct, it seems a more durable spring is secured. We present this as a new idea in the manufacture of engine and tender springs for your consideration.

John Mackenzie,
Wm. Swanston, } Committee.
J. S. Porter,

DISCUSSION ON SPRINGS AND EQUALIZERS.

Mr. Sprague.—I move that the report be received.

The motion was carried.

The President.—The report is received and is now open for discussion.

Mr. Mackenzie.—In talking of this matter of the shape of the spring band, the committee say they would not recommend making the spring band wider at the bottom than at the top. This question came up through an answer of Mr. Porter, one of the committee, who said he was using them with a great deal of satisfaction. In talking with one of our spring makers, the question came up, why did he make the spring band wider at the top than at the bottom. The natural tendency of straightening out the plates would make it still worse on the lower plate, it would seem to us. We simply take the band and turn it upside down and we have got the band as the committee show it in this cut. I was in hopes of having some tests made of the spring under the testing machine, showing the line of the plate, but we have been unable to get them. I would say, however, that we have a set of them running and they give excellent satisfaction. The engine runs very much more easily than before. Of course we have a very long spring in this case, but I claim that with this engine we get a great deal better action on the spring than we did with the band. It is only a question in my mind now, how small that band can be made to give a free action to the spring. I call attetion to the great diversity of opinion in respect to the number of plates required. You will see that very few of the replies speak alike. The majority of them are carrying a great deal more steel than is necessary. I believe that the recommendation of the committee is altogether too heavy. They run from 10 to 16 plates; it seems to me that there is too much difference there. As to the matter of standard as recommended by the committee, it is a question in my mind whether that is not altogether too much. I would like to hear the members discuss that very thoroughly, those that are able to discuss it.

THE PRESIDENT.—It seems to me that the recommendation of the committee is very important and deserves very careful consideration.

MR. SWANSTON.—With regard to the number of plates in a truck, it is understood, of course, that there are 34,000 pounds on that truck. We have a number of engines with that weight, and our experience is that we cannot keep them up with less than 16 leaves. That, however, is a very heavy front end. Lighter engines, of course, have a lighter spring. We have truck springs down as low as 12, some as low as 10. That is a small engine. The type of spring that is here recommended is for the very heaviest American engines.

MR. MACKENZIE.—We gave the weight for each spring—the weight upon the driving wheel and also the weight upon the truck, and the engines following here are supposed to carry that weight—not anything else.

SECRETARY SINCLAIR.—I see the committee recommend the slotting of the frame for the post. That is an old practice that I have often heard condemned, and I think it would be well for the members to give an expression of opinion on it, and I would like also to emphasize, if possible, the fact that the paper recommends a standard which would be referred to as the standard of the Master Mechanics' Association, and if the members do not consider it is the right thing, now is the time to say so and not to ignore it after the report is adopted and continue their own practice, differing from the recommendation of the committee.

MR. MACKENZIE.—In regard to the recommendation of slotting the frame, we had, I think, some three or four roads saying that they preferred that to the bolts. Mr. Swanston, in making his report on that, relates that he has some two or three engines, I think, with the frame slotted on his road and some hundreds without it. He has never had a bolt nor a stirrup broken in the case of these engines, but in the other case the bolts are continually breaking. My own experience is that with the posts slotted in the frame it is much preferable, for the reason that you get the action of the equalizer front and back, which you did not get with the posts. You hang your equalizer on a pivot, as it were, and the equalizer is allowed to go with the action of the spring. For that reason the committee recommend it. As to the cost of them, the first cost perhaps would be a little more, but I find we can make that job in the blacksmith shop as well as we can in the machine shop. It is the practice of the Union Pacific, I believe, to use that post entirely. They do not use anything else.

THE PRESIDENT.—I understand Mr. Mackenzie's recommendation applies only to the equalizer.

MR. MACKENZIE.—That is all, sir.

On motion, the discussion was closed.

THE PRESIDENT.—The next business in order is the report of the committee on tires—advantage or otherwise of using thick tires.

REPORT ON TIRES—THE ADVANTAGE OR OTHERWISE OF USING THICK TIRES.

The Secretary read the report of this committee, which is as follows:

The committee appointed at the St. Paul convention, 1887, to investigate "Tires: Advantage or otherwise of using thick tires," report as follows:

Circulars were issued to members containing a series of questions, as herewith given:

TIRES—ADVANTAGE OR OTHERWISE OF USING THICK TIRES.

There are two methods of determining the relative value of thick as compared with thin tires. One is by making tests of the density of a number of specimens of each from the same maker, to determine whether the soft core is proportionally larger in one than the other. This method is misleading and cannot be accepted as conclusive, since it has not yet been definitely established whether the rolling friction desired may not be greater in a soft tire, nor does this method take into account the elements other than relative density which cause abrasion of the tire surface, as the frequent use of sand, slip incident to curves, slipping on grades, over-cylindered engines, etc. The other is the crucial test of daily wear, and includes all the causes which combine to wear the tire. To make a reliable comparison of these values the committee require tabulated information showing the mileage made during the lifetime of a series of heavy and light tires of same makes, which the committee request you to furnish upon blanks similar to the one herewith sent you. In addition please state:

1.—Does the use of heavy tire increase the adhesion of the engine enough to appreciably reduce the quantity of sand required?

2.—What observations have you made upon the influence the

NAME OF ROAD.	No. of Engine.	Kind of Service.	Kind of drivi'g wheel Brake.	Brand of tire.	Original thickness.	Miles run before first turning.	Thickness after 1st turning.	Miles run to 1-16 in. wear before 1st turning.	Miles run before second turning.	Thickness after 2d turning.	Miles run to 1-16 in. wear between 1st and 2d turning.	Miles run before third turn'g.	Thickness after 3d turning.	Miles run to 1-16 in. wear between 2d and 3d turnings.	Miles run to removal.	Thickness at removal.	Miles run to 1-16 in. wear between last turn'g and remo'l.	Total mile'ge.	Average miles run to 1-16 in. wear.
Lake Shore & M. S. Ry.*	322	Frt.	St'am	A	3	19481	2 12/16	8470	71974	2 4/16	8997	59649	1 12/16	7456	88700	1 2/16	14783	265911	8863
Lake Shore & M. S. Ry.	205	Sw.	None	A	3	56387	2 9/16	8055	65719	2	7302	45948	1 11/16	9189	43435	1 4/16	6205	211489	7553
Lake Shore & M. S. Ry.	299	Frt.	Ste'm	B	3	23256	2 12/16	5814	51932	2 3/16	5770	45638	1 10/16	5070	54412	1 6/16	13603	175238	6740
Grand Trunk Ry.	8	Frt.	None	C	2⅞	49501	2 4/16	4950	43758	2	10939	37599	1 10/16	6266	53830	1 3/16	7690	184688	6840
Grand Trunk Ry.	42	Frt.	None	D	2⅞	25266	2 9/16	5053	50906	2 3/16	8484	52927	1 9/16	5292	39107	1 4/16	7821	168206	6469
Grand Trunk Ry.	77	Frt.	None	E	3	84354	2 10/16	14059	37908	2 3/16	5415	60619	1 10/16	6735	30516	1 6/16	7629	213397	8207
Lake Shore & M. S. Ry.	85	Frt.	Ste'm	B	3	36176	2 12/16	9044	60856	2 3/16	6761	65391	1 11/16	8189	41410	1 4/16	5915	203833	7279
Lake Shore & M. S. Ry.	468	Sw.	Ste'm	B	3	36189	2 11/16	12063	56606	2 5/16	7083	64621	1 9/16	5385	56445	1 4/16	11289	213861	7637
N. Y., C. & St. L. R. R.	3	Frt.	None	A	2 6/16	63576	1 13/16	7063	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	13	Frt.	None	A	2 6/16	77979	1 11/16	7089	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	21	Frt.	None	C	2 4/16	77427	1 11/16	8603	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	32	Frt.	None	A	1 12/16	29065	1 7/16	5813	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St L. R. R.	42	Frt.	None	A	1 9/16	28916	1 5/16	7229	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	49	Frt.	None	A	3	45032	2 12/16	11258	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	169	Frt.	Air	A	2 5/16	51928	2 1/16	12982	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	175	Frt.	Air	A	2 3/16	52484	1 15/16	13121	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St L. R. R.	38	Frt.	None	A	1 9/16	55096	1 5/16	13774	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	38	Frt.	Air	A	1 9/16	55096	1 2/16	7871	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	38	Frt.	Air	A	1 9/16	55096	1	6122	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	51	Frt.	None	A	1 6/16	46854	1 3/16	15618	----	----	----	----	----	----	----	----	----	----	----
N. Y., C & St. L. R. R.	51	Frt.	Air	A	1 6/16	46854	1	7809	----	----	----	----	----	----	----	--	----	----	----
N. Y., C. & St. L. R. R.	62	Frt.	None	A	1 7/16	54720	1 2/16	10944	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	62	Frt.	Air	A	1 7/16	54720	15/16	6840	----	----	----	----	----	----	----	----	----	----	----
N. Y., C, & St. L. R. R.	62	Frt.	Air	A	1 7/16	54720	14/16	6080	----	----	----	----	----	----	----	----	----	----	----
N. Y., C. & St. L. R. R.	57	Frt.	None	A	1 15/16	63138	1 12/16	21046	----	----	----	----	----	----	----	----	----	----	----

N. Y., C. & St. L. R. R.	57	Frt.	Air	A	$1\frac{15}{16}$	63138	$1\frac{9}{16}$	10523	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
Wisconsin Central Line	56	Frt.	None	A	$3\frac{1}{2}$	98733	$3\frac{2}{16}$	16455	47709	$2\frac{12}{16}$	7951	-----	----	-----	-----	----	-----	-------	----
Wisconsin Central Line	57	Pas	None	A	$3\frac{1}{2}$	97914	$3\frac{4}{16}$	24478	41523	$3\frac{2}{16}$	20761	-----	----	-----	-----	----	-----	-------	----
Wisconsin Central Line	100	Pas.	None	B	$3\frac{1}{2}$	57637	$3\frac{2}{16}$	9606	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
Peoria & Pekin Union Ry.	3	Sw.	None	A	4	46304	$3\frac{8}{16}$	5788	30093	$3\frac{1}{16}$	4298	-----	----	-----	-----	----	-----	-------	----
Peoria & Pekin Union Ry.	4	Sw.	None	A	4	46656	$3\frac{10}{16}$	7776	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
Peoria & Pekin Union Ry.	5	Sw.	None	A	4	42976	$3\frac{8}{16}$	3372	42918	$3\frac{2}{16}$	7153	-----	----	-----	-----	----	-----	-------	----
Peoria & Pekin Union Ry.	6	Sw.	None	A	4	43118	$3\frac{7}{16}$	4791	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
Peoria & Pekin Union Ry.	7	Sw.	None	A	4	23394	$3\frac{11}{16}$	4679	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
Peoria & Pekin Union Ry.	8	Sw.	None	A	4	48490	$3\frac{6}{16}$	4849	33080	$2\frac{13}{16}$	4135	23292	$2\frac{5}{16}$	2588	-----	----	-----	-------	----
N. Y., C. & St. L. R. R.†	18	Frt.	None	B	4	39932	$3\frac{14}{16}$	19966	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
N. Y., C. & St. L. R. R.	38	Frt.	None	C	4	26450	$3\frac{14}{16}$	13225	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
N. Y., C. & St. L. R. R.	38	Frt.	Air	C	4	26450	$3\frac{12}{16}$	6612	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
N. Y., C. & St. L. R. R.	51	Frt.	None	A	$3\frac{15}{16}$	37458	$3\frac{13}{16}$	18729	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
N. Y., C. & St. L. R. R.	51	Frt.	Air	A	$3\frac{15}{16}$	37458	$3\frac{12}{16}$	12486	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
N. Y., C. & St. L. R. R.	62	Frt.	None	A	4	22718	$3\frac{14}{16}$	11359	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
N. Y., C. & St. L. R. R.	62	Frt.	Air	A	4	22718	$3\frac{13}{16}$	7576	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
N. Y., C. & St. L. R. R.	61	Frt.	None	C	$4\frac{1}{16}$	50208	$3\frac{15}{16}$	25104	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
N. Y., C. & St. L. R. R.	61	Frt.	Air	C	$4\frac{1}{16}$	50208	$3\frac{14}{16}$	16736	-----	----	-----	-----	----	-----	-----	----	-----	-------	----
Peoria & Pekin Union Ry.	1	Sw.	None	B	3	48960	$2\frac{7}{16}$	5440	61425	$1\frac{10}{16}$	4725	-----	----	-----	-----	----	-----	118477	----
Peoria & Pekin Union Ry.	1 } 2d set	Sw.	None	A	3	55473	$2\frac{5}{16}$	5043	30618	$1\frac{12}{16}$	3402	18509	$1\frac{6}{16}$	3085	-----	----	-----	-------	----
Peoria & Pekin Union Ry.	2	Sw.	None	B	3	-------	----	-----	106232	$1\frac{14}{16}$	5901	-----	----	-----	-----	----	-----	142287	----
Peoria & Pekin Union Ry.	2 } 2d set	Sw.	None	A	3	43296	$2\frac{4}{16}$	3608	39784	$1\frac{12}{16}$	4973	-----	----	-----	18558	$1\frac{7}{16}$	3711	101638	4065
Peoria & Pekin Union Ry.	3	Sw.	None	B	3	-------	----	----	95361	$1\frac{6}{16}$	3668	-----	----	-----	-----	----	-----	-------	----
Peoria & Pekin Union Ry.	4	Sw.	None	B	3	-------	----	-----	119357	$1\frac{12}{16}$	5968	-----	----	-----	-----	----	-----	148440	----
Peoria & Pekin Union Ry.	5	Sw.	None	B	3	-------	----	-----	125537	$1\frac{4}{16}$	4483	-----	----	-----	-----	----	-----	152613	----
Peoria & Pekin Union Ry.	6	Sw.	None	B	3	47208	$2\frac{4}{16}$	3934	-------	----	-----	-----	----	-----	-----	----	-----	119299	----
Peoria & Pekin Union Ry.	7	Sw.	None	B	3	-------	----	-----	128596	$1\frac{8}{16}$	5358	-----	----	-----	-----	----	-----	160432	----
Peoria & Pekin Union Ry.	8	Sw.	None	B	3	47864	$2\frac{8}{16}$	5983	57260	$1\frac{10}{16}$	4090	-----	--	-----	-----	----	-----	137670	----
Peoria & Pekin Union Ry.	10	Sw	None	B	3	-------	----	-----	105560	$2\frac{3}{16}$	8120	-----	----	-----	-----	----	-----	105560	----
Peoria & Pekin Union Ry.	11	Sw.	None	B	3	135676	$1\frac{8}{16}$	5653	-------	----	-----	-----	----	-----	-----	----	-----	-------	----
Peoria & Pekin Union Ry	12	ps&ft	None	B	3	-------	----	-----	149324	$2\frac{5}{16}$	13575	-----	----	-----	-----	----	-----	149324	----

* Engine 322, L. S. & M. S., also showed 26,107 miles run before 4th turning; thickness of tire after 4th turning, 1 8-16 inches; miles run to 1-16 inch wear between 3d and 4th turnings, 6,527.

† All of the reports of the N. Y., C. & St. L. railroad were taken with the Mackenzie tire indicator.

engineer exerts upon the wear of tires? Can his manner of handling the engine affect the lifetime of the tires to any great degree?

3.—Do you consider it advisable or otherwise to increase the weight of driving wheel centers beyond the actual weight necessary for strength and durability, in order to gain adhesive power, or would it be advisable to add such weight where it would be relieved by springs?

4.—Do not heavy wheel centers with thick tires produce flat spots upon the tread of tires much sooner than light wheel centers and light tires?

5.—Is your road heavily graded or comparatively level, and what is the character of the traffic? As to passenger, are trains run fast with frequent stops? Also, are your freight rated to a high maximum of cars per train?

The name of makers and comparative value of different makes of tire will be regarded as strictly confidential between makers of reports and the committee.

The committee expected by compiling the annexed tabular statements to be able to show whether the larger soft core in the central part of the thick tires wears away more rapidly than the relative smaller core in the thin tires. As no 4-inch tires are reported upon from the time of application until removed, the committee is unable to give as definite information as it might have done if it had received reports from a large number of 4-inch tire showing the wear of same during their lifetime.

The principal basis from which a report can be framed, will therefore be to show the mileage made by the outer part of 3-inch tires as compared with the central part after first, second and third turnings.

The tabular exhibit herewith given has been prepared with this object in view. The extremely contradictory experience of different tires under the same general conditions of wear, make it apparent, that other causes than the character of the steel of which the tire is made or its relative density, very largely determine the mileage obtained from any thickness or brand of tire.

To the inquiry as to whether additional weight increases the adhesion to any appreciable extent or decreases the use of sand, reports generally are in the negative except J. W. Hill who believes that the increased diameter decreases the amount of sand used. Mr. Clem Hackney of the Union Pacific says: four inches finished is now our standard thickness for all new tires put on, but so far we do not find their use appreciably reduces the quantity of sand used.

Mr. C. E. Smart says : I do not think that the use of heavy tire increases the adhesion of the engine so as to appreciably reduce the quantity of sand required.

To the inquiry as to the influence which the engineer exerts on the wear of tires—

Mr. T. B. Twombly says that from a careful comparison of records he has arrived at the conclusion, that the slipping of wheels is one of the most important elements in the wear of tires.

Mr. Clem Hackney says, no doubt the manner of handling the engine, especially when in switching service, has considerable effect on the life of the tire.

Mr. C. E. Smart says : From my own experience and observation I am satisfied that by careful handling and judicious use of sand a careful, competent engineer can and will reduce tire wear fully 25 per cent. over the engineer who takes no particular interest in his work except to draw his pay.

Mr. Francis R. F. Brown of the Canadian Pacific says : In my experience the engineer to a very large extent has the life of the tire under his control ; given two locomotives equal in weight and dimensions and with the same make of tire, and the engineer of one being a careful, intelligent man who studies the interest of the company which he serves, and the engineer of the other being of the class who only care to draw their monthly pay, the first named will make his tires last three times the life of the second, with a consequent saving of fuel, wear and tear, and economy in repairs.

Mr. D. Drummond of the Caledonian railway says : The careful handling of an engine doubtless contributes to the duration of the tire.

Mr. G. W. Stevens says : My observation confirms the belief that the manner of handling an engine by the engineer affects the life time of tires to a great degree.

Mr. H. Schlacks says : That personal observation upon three engines of similar dimensions and with tires of same makes, now in suburban traffic, each having a regular engineer, two have had their tires turned and will shortly require a second turning, while the first is not yet sufficiently worn to require a first turning; and this he says is directly attributable to the cautious and intelligent work of the engineer, who continually cares for the welfare of the engine by using but little sand and doing very little slipping.

Mr. Jas. W. Hill says: With switching engines that are over-cylindered the engineers' manner of handling can affect the life time of the tires as much as one-half.

Wm. Swanston says: In my report to the committee on tires last year, I reported the answers of our road foreman of engines and a number of engineers as well as my own opinion, that the engineer has a very considerable influence on the wear of tires.

Mr. J. Davis Barnett says: Careless and short tempered men by unduly slipping engine wheels waste the metal of the tires.

Mr. T. W. Gentry says: I am of the opinion that the engineer in charge of an engine can, by exercising care in the use of the throttle, the application of sand, and the reverse lever, in connection with good judgment in applying driver brakes, greatly influence the wear of tires, and his manipulation of those appliances has much to do with the lifetime of tires.

Mr. John Player says: The most careful man, the one who uses the least amount of sand to keep his engine from slipping, show the least wear of tires, to what extent I have no data to show, but have noticed a great difference in time between turnings of tire between two engines of same class with same brand of tire, handled by two different men.

Mr. T. B. Twombly says; To the question of whether it is advisable to increase the size of wheel centers, that he will prefer to put the weight where it will be relieved by springs.

Mr. John Player says: I do not consider it advisable to increase the weight of driving-wheel centers beyond actual weight necessary for strength and durability to gain adhesive power; would prefer to add the weight where it can be relieved by springs.

Mr. Clem Hackney says: I do not consider it advisable to increase the weight of drivers beyond the actual weight necessary for strength and durability to gain adhesive power; would prefer to add such weight where it would be relieved by springs.

Mr. C. E. Smart says: I do not consider it advisable to increase the weight of driving-wheel centers beyond the weight necessary for strength and durability, but consider it highly advisable to put the requisite weight where it will be relieved by springs.

Mr. C. E. Smart further submits a comparative statement showing actual wear, etc., which is herewith submitted, and is a very important part of this report. From this it may be seen, that imperfect designing of wheel centers wherein unnecessarily great masses of iron irregularly distributed, may cause hammering and may show wear upon the tire, for which the tire is not in any measure responsible but which may easily mislead.

COMPARATIVE STATEMENT SHOWING ACTUAL WEAR AND FLAT SPOTS ON LOCOMOTIVE TIRE AS BETWEEN HEAVY AND LIGHT WHEEL CENTERS.

HEAVY WHEEL CENTERS.					LIGHT WHEEL CENTERS.				
Engine.	Original thickness of tire.	Turning.	No. of 16ths of an inch turned off For		Engine.	Original thickness of tire.	Turning.	No. of 16ths of an inch turned off For	
			Wear	Flat spots				Wear	Flat spots
	Inches					Inches			
2	3	First	6	2	220	3	First	5	2
"	------	2nd	4	2	"	------	2nd	8	3
"	------	third	2	2	"	------	----	------	----
9	3	First	5	2	221	3	First	8	3
"	------	2nd	4	1	"	------	2nd	4	3
"	------	third	4	2	"	------	third	5	2
13	3	First	3	3	222	3	First	4	1
"	------	2nd	4	1	"	------	2nd	6	2
"	------	third	4	2	"	------	third	4	2
252	3	First	5	2	223	3	First	5	2
"	------	2nd	5	3	"	------	2nd	6	1
"	------	third	3	2	"	------	third	4	1
253	3½	First	5	5	224	3	First	7	3
"	------	2nd	2	1	"	------	2nd	5	2
"	------	third	4	2	"	------	----	------	----
255	3½	First	2	2	225	4	First	5	2
"	------	2nd	4	1	"	------	2nd	6	2
"	------	third	2	3	"	------	----	------	----
Totals	------	-----	68	38	Totals	------	-----	82	31

Percentage of flat spots as to wear of tire on heavy wheel centers is about 56 per cent.	Percentage of flat spots as to wear of tire on light wheel centers is about 37 per cent.

Showing 19 per cent, difference in favor of the light wheel center as to flat spots. The above statement is made without regard to mileage, and is only to show the supposed effect of a heavy wheel center over a light wheel center on tire.

It should be stated that the engines having the heavy wheel centers are about 10.000 lbs. heavier on their drivers than the engines having the light wheel centers.

Mr. Francis R. F. Brown says: Weight should be added above the springs.

Mr. T. W. Gentry says: I do not consider it advisable to increase the weight of driving-wheel centers beyond the weight actually necessary for strength and durability. I think, however, that many builders and designers make the main and crank hubs too light. Would advise that all weight added to increase the adhesion be placed where it would be relieved by springs, and that it consist, when possible, of large heating surface and increased size of boilers.

Mr. J. Davis Barnett advises to make the wheel just heavy enough for strength and have all other weights where it would be transferred to the wheel through the elastic medium of a spring, because all inference drawn from experiments on the transfer of motion through friction wheels compressed together, is in favor of the supposition that the surface contact between tire and rail is increased by the use of a spring; this is due to the wheel closely following the inequalities of the track instead of bouncing from point to point.

Mr. Wm. Swanston says: I do not consider it advisable to increase the weight of driving-wheel centers or tire beyond what is necessary for strength and durability, but much prefer that the additional weight be relieved by springs, he also expresses the opinion that the comparison of a few sets of tires is very misleading, and it is very difficult to account for the results that sometimes occur; he gives the following illustration: Two switching engines on his road both built from the same drawing with six driving wheels 44 inch centers, cylinders 18x22, weight on driving wheels 82,000 pounds, both went into service August 25, 1885, both came into the shop for repairs in October, 1886, the record of the tire turning at that time was as follows:

NUMBER OF ENGINE.*	Original thickness of tires.	Thickness after turning.	Miles run before turning.	Miles run to 1-16 in wear.	Maker's name.	Per cent. of wear.
341............	3 in.	$2\frac{5}{16}$	42707	3883	A	51
632...............	3 in.	$2\frac{11}{16}$	38194	7639	B	100

The attention of the manufactures of tire A. was called to this fact, also note that their tire was much harder to turn and took double the time in the lathe. They furnished another set of special make much softer, but before we put them on the 341 had made 22,384 miles with the former tires with a loss in thickness of $\frac{9}{16}$ or a mileage of 2,487 to the $\frac{1}{16}$ inch. The new tires were put on in June 1887, and were in the shop in March, 1888, during that time they had made 21,168 miles with a loss of $\frac{5}{16}$ or 4,234 miles to the $\frac{1}{16}$ inch. Engine No. 632 was also in the shop in March, 1888, and had its tires turned for the second time with a loss of $\frac{9}{16}$ inch to 51,454 miles or 5,717 miles to $\frac{1}{16}$ inch wear. The marked difference in the mileage of these tires requires explanation which it is hard to give. I do not believe it is altogether in the quality of the tires, the engines are in the same kind of service but in different yards, and No. 341 had a number of different men running it while the 632 had but few changes of men. For such widely different results as this it seems to me impossible to determine the causes which produce them, and if in this case there had been a difference in the thickness of the tires it would be manifestly unfair to have given the thickness any credit.

Mr. G. W. Stevens says: As a rule I should not consider it advisable to increase the weight of driving wheel centers beyond the actual weight necessary for strength and durability in order to gain adhesive power.

Mr. Jas. W. Hill says: I do not consider it advisable to increase the weight of wheel centers beyond the actual weight necessary for strength and durability; better to add the weight where springs would relieve it.

Mr. C. E. Smart replies to the question of whether heavy tire are more likely to increase the hammer blow, heavy wheel centers with thick tire do produce flat spots upon the tread of tire much sooner than light wheel centers and light tires. I enclose a statement giving a record of six engines having heavy wheel centers as compared with six engines having light wheel centers which may be the means of opening up a view in the tire question, that will, at least, be a good point for discussion.

Mr. J. W. Hill believes that heavy tire will produce flat spots in a majority of engines, but if the moving parts are balanced at the average speed that the engines is to run the heavy tire will not produce them.

This virtually assumes that the flat spots are caused by imperfect balancing in wheel centers.

Clem Hackney says: I have not found that thick tires have produced flat spots on tread any oftener than light tires.

Mr. T. W. Gentry says: Many who speak from experience claim that the hammer blow, or concussion from heavy wheel centers and thick tires, is greater than that produced by light forms, and that flat spots appear sooner and increase faster.

He also offers the following statement of the wear of tires upon engines upon the Richmond & Danville railroad which shows the part of wear for which the brake, and not the actual wear due to work, may be responsible, it also shows the different effect of wear, as between large and small sized wheels, attention is specially asked to the performance of 18x24 Baldwin passenger engines, some having 60 inch tire, and others having 66 inch tire, the effect of the Ross-Meehan shoe is also shown, as compared with the ordinary flat bar shoe.

He says, "Our road has maximum grade of about 70 feet; average about 50 feet. Traffic consists of compressed cotton, fertilizers, coal, ores and merchandise. Has several grades over six miles long, average about 40 to 60 feet. Passenger trains are run fast (45 miles per hour) and make frequent stops. Freight engines average 34, loaded 40,000 lbs., cars per train.

The tire performance given below was made under the above conditions. Engines are 20x24 inch Baldwin consolidation type; total weight of same 118,000 lbs., weight on drivers 104,000 lbs., on pony truck 14,000, weight of engine and tender, 175,000 lbs.

Outside diameter of tires 50 inches; average mileage of six sets of tires to first turning was 64,000 miles, original thickness three inches; thickness after first turning 2¾ inches; or a reduction in thickness of ¼ inch, an average of 8,000 miles for each $\frac{1}{32}$ inch of wear.

Rail is the ordinary section of 60 lbs. steel. These tires would have made more miles, but were stopped on account of flanges wearing unevenly. They were also equipped with the ordinary cast iron brake head, with flat wrought iron shoe, or lines in contract with tire; rigged on American "outside" plan, using compressed air, instead of steam for power. Several of these engines were equipped with Ross style of brake shoes after their first turning and some with Ross-Meehan shoe. Some of the latter have made 70,000 miles and tires are not bad, though they need turning up and sizing. They are reduced as near as I can measure about $\frac{5}{16}$ inch since first turning, or a total reduction in thickness of $\frac{9}{16}$ inches for 134,000 miles, or about 14,900 miles to $\frac{1}{16}$ inch decrease in thickness.

At this rate these tires should make about a total of 417,200 miles; as we remove them at 1¼ inches; but as experience teaches us they wear faster after first and second turnings, they may, of course, fail to keep up this ratio.

I should add that none of these tires were turned off on face of treads when first applied. Great care was taken to get them of one diameter, and as near round as possible, and the flanges, back and outside faces were trued up and balanced.

The actual mileage of many of the tires that are included in this lot, would have been greater under ordinary conditions, some of them having been slid flat by reversing and applying driver brakes in emergency stops which caused their trueing up, before they were much worn, but as a whole, we consider it a fair average for this class of engines.

I also have some data on tire wear on new Baldwin passenger engines, 18x24 cylinders, 60-inch and 66-inch wheel engines weigh 90,000 lbs.: 56,000 lbs. on drivers and 34,000 lbs. on truck. Engines and tender weigh 145,000 lbs. Engines equipped with Westinghouse driver brakes, and first mileage given in the record below was made with the ordinary flat wrought iron shoe, while second was with Ross-Meehan shoes. The figures given are accurate, and show plainly the advantage of reducing tire wear by increasing diameter, and also show advantage of Ross-Meehan shoes over old style.

The engines with the 66-inch wheels ran same schedule over same road as those with 60-inch wheels, and time consumed in getting under way after stopping averages nearly same with both classes, *i. e.*, the smaller wheels slip easily and the larger ones do not, but hold and move off slowly :

	Original thickness	Miles run to 1st turning.	Thickness after st turning.	Miles run to 2d turning.	Thickness after 2d turning.
60 inch tires	3 in.	48,000	$2\frac{3}{4}$ in.	54,000	$2\frac{3}{8}$ in.
66 inch tires	3 in.	77,000	$2\frac{11}{16}$ in.	35,000	$2\frac{7}{16}$ in.

In concluding this report the committee suggests that the information sought for is not yet as available as could be desired, and further suggests that master mechanics would do wisely, in view of the importance of the question of relative wear of tires, and of the greater economy which would be obtained by using thick tires if they were found to be as efficient in wear as the thin tire, to introduce the continued use of a tire gauge similar in operation to that used by Mr. John Mackenzie, for the purpose of computing averages.

If a committee could be furnished with sufficient data, it might be able to determine this question. but it could only be done with certainty upon the computation of a large list of averages; meanwhile there are continued improvements in tire manufacture in progress, both in the nature of the steel and in rolling, and larger engines are being required for the increased tonnage, and it would almost seem impertinent in the progressive state of steel tire making to attempt to fix a limit of size or durability in tires.

The committee believes that this vital, economic question should not be dismissed until a definite list of averages has shown to the satisfaction of all inquiry, the true relative value of heavy tire in comparison with light, and suggests that the work of the committee be carried over or a new committee be placed to further the work herewith initiated, as it is evident that very few 4-inch tire have yet been worn out; such committee should be authorized to arrange for the use of the tire outline indicator, and have a number of them put into use where care and certainty of measurements would be assured. Thus only can its work be made permanently valuable.

J. W. STOKES,
H. SCHLACK, } Committee.
C. E. SMART,

MR. HICKEY.—I move that the report be accepted.

The motion was carried.

MR. HICKEY.—If it is in order I would like to move an adjournment until to-morrow morning at 9 o'clock.

THE PRESIDENT.—It is only 1 o'clock and we have a number of reports yet.

MR. MACKENZIE.—I think as Mr. Hickey thinks; we have sat here four hours continuously. We are not only hungry but we are tired.

A *viva voce* being taken on the motion to adjourn, the chair was unable to decide whether or not the motion was carried. A standing vote was then taken and 21 voted in favor of the motion to adjourn and 20 against it.

THE PRESIDENT.—The motion to adjourn is carried. We stand adjourned until to-morrow morning at 9 o'clock.

THIRD DAY.

The Convention was called to order at 9, A. M.

DISCUSSION ON TIRES.

THE PRESIDENT.—The first business in order this morning is the discussion of the subject of tires; the advantages or otherwise of using thick tires. The committee are J. W. Stokes, C. E. Smart and Henry Schlacks. None of the committee are here. Will some member open the discussion? We wish to have our discussions sharp and quick in order to be able to get through with our business. This is a subject that has occupied a good deal of time at some of our clubs.

MR. O. STEWART.—It has been stated by our president that this matter has been discussed freely in our club meetings; it has been at our New England club, at any rate, and the opinion expressed there is, that the thick tire, the 4-inch tire, had been in use so short a time that there was no data on which we could really base any opinion as to the value or merit of the 4-inch tire over the 3-inch, and there is just where the whole matter rests. We have not used the tire long enough to enable us to determine whether there is any advantage in using the thick tire other than adding weight to the engine.

MR. GRORGE W. STEVENS.—I move that the discussion be closed and the committee continued for another year.

MR. STEWART.—I second the motion.

THE PRESIDENT.—You have heard the motion. Are there any remarks?

MR. LAUDER.—I think that report, as given to the Association, merits a little criticism. Now, it is not very pleasant for any member to get up in open convention and criticise a report rendered by other members of the Association; but when we sat here yesterday afternoon and heard the document read called a report, it seemed to me that somebody ought to enter a vigorous protest against the presentation of such report as that. I think this is a fair illustration of the character of reports that I have been fighting against for the last fifteen years in this Association. I think that a committee is bound to put labor enough and time enough and thought enough into a report, to make it a creditable one to this Association. Now, this report is evidently prepared with some labor; but it is the system, the character of the report, that I object to more than its matter. I do not believe that any committee has any right to collect a mass of opinions from Tom, Dick and Harry all over this country, good men, poor men and indifferent men, and fire those opinions at the Secretary here and call it a report. That is just what this committee does; it is simply what Tom says, what Dick says and what Harry says, and it draws no conclusion. It has nothing definite. It neither expresses the opinion of the committee nor of anybody else—only a mass of individual opinions and experiences of men who have not had time to give it any thought. They answer the circular as a matter of courtesy to the committee and the Association, and without giving any tests or getting down, as my friend Stevens says, to cold facts. I do not want, of course, to bear hard on my associates in this convention. I do not want to seem to criticise the methods that any man sought fit to adopt in presenting a report here, but I do think that our annual reports ought not to be lumbered up with a lot of opinions in answer to questions issued in the form of a circular. The information gained by the replies to these committee circulars should be taken into account in making up the report, of course, and where it requires statistics it is the only way, perhaps, that we can get valuable reports; but they should be condensed by the committee, and the task should not be put upon the Secretary of re-writing a report and condensing it so that it will occupy fair space in our annual report. I assume this committee must have labored under a good deal of embarrassment in making up this report, from want of positive knowledge on the subject. As Mr. Stewart says, we have not used thick tires long enough to determine their relative value, and no one, perhaps, has made practical experiments enough to determine what is the best thickness of tire, but there are sources of information that might have been of value to this Association had they been properly worked up. A year and a half ago I was at one of the meetings of the Chicago Club, and Mr. Rhodes, of the C., B. & Q., presented some statistics, some actual facts that do not appear in this report, and those facts I think at the present time could be got from the C., B. & Q. road in a vastly better way than to issue a general circular, which is apt to be thrown into the waste basket and forgotten. Now, Mr. Rhodes' figures, as presented at the Western Railway Club, while they were not conclusive, as he well stated, did point to the fact that a three-inch tire was about as thick as you could get of first-class wearing material. In fact, his figures showed that a three-inch tire had given almost as much service as a four-inch in similar service. Of course, we must admit that the engineer has a good deal to do with the wear of tires; but Mr. Rhodes' figures, given from a large number of engines, as far as they went showed very conclusively, and all pointed in the direction, that a three-inch tire gave very much more wear than a four-inch in proportion to its thickness, and in a large number of cases the aggregate mileage on a three-inch tire was very nearly as much as it was on a four-inch. Now, if that is the fact it is something we ought to know, because no man wants to pay four or five or six cents a pound for that extra inch, unless he is going to get a corresponding wear. I should like to have some other man make this suggestion, because I do not want to stand alone in criticism of this report. I have heard it suggested that a committee was appointed to report on the relative merits of four-inch and three-inch tires, and most of the report is devoted to foreign questions; but the report, I suppose, if carefully considered, will have some value anyhow. It will give us the opinion of leading men throughout the country. Beyond that it is of no use that I can see.

SECRETARY SINCLAIR.—I think Mr. Chapman is here. It would be interesting to hear from tire-makers, their views on the practicability of rolling a thick four-inch tire as densely as a three-inch or a thinner one.

MR. N. E. CHAPMAN.—It seems to me that there is very little that I can say here on this subject that would be of benefit to the Association, except my own individual opinion, which is that the users of tires have been going to an extreme in the using of thick tires. We have orders for four-inch and have had some orders for five-inch tires. My experience was, when I was using tires, that we got more mileage from a two and a half-inch tire than from a three-inch tire. We, of course, make a tire to suit our customers; if a man wants a four-inch tire, we give it to him. Many of the roads are using four-inch tires; others have fixed upon three-inch. One road I have in my mind now, that fixes upon a three-inch tire, gives us a margin of three and a quarter. If the tires are over three and a quarter inches they do not like to accept them. I suppose the reason for that is, they think they get a better mileage than they do with a thicker tire. There are some features in connection with the manufacture of tires that perhaps are not known to the consumer. I do not think the metal on a thick tire is as dense at the center as in the three-inch tire. The cooling on the center of the tire certainly has a greater effect upon a tire of four inches in thickness than one of three inches. The metal is more inclined to granulate at the center; it is not as dense. From my recollection of the reading of Mr. Rhodes' report, which Mr. Lauder mentioned, he said that he got very little increased mileage from his four-inch over what he got from his three-inch tires. I was talking with one of our old members, Mr. Samuel Cummings, not long ago on that subject. He said if he was in the service again he would not use tires over two and a half inches thick. He could get more service from them; they would be cheaper for the load.

The motion to close the discussion upon this question and to continue the committee for another year was carried.

APPOINTMENT OF COMMITTEES.

SECRETARY SINCLAIR.—I move that the reports of committees be taken up now, as they will need some time to perform their work. We can go on with the other business in the meantime.

The motion was carried.

THE PRESIDENT.—I will appoint as a committee on the next place of meeting, John Mackenzie, O. Stewart and George Hackney.

I will appoint as a committee for the nomination of officers, J. N. Lauder, J. Davis Barnett and W. H. Selby, and John Player to take the place of Charles Blackwell on the committee on subjects.

DISCUSSION ON NEW CONSTITUTION.

MR. LAUDER.—There was a committee appointed at the last meeting, and instructed to bring in a draft of a new constitution. That committee have attended to their duties, and have unanimously agreed upon a new draft of a constitution; and inasmuch as that constitution, if adopted, will, I think, have some bearing upon this question of selecting a place of meeting, if it is in order I would move that the report of the committee be considered at the present time.

THE PRESIDENT.—It will be necessary to move to dispense with the rules.

MR. LAUDER.—I would move that the by-laws be so far suspended as to admit our considering the report of the constitution committee at the present time. I do not think there ought to be any objection to it. It ought to be considered, as it will embarrass us in some of our actions if it is not considered and afterwards adopted.

The motion to suspend the rules and take up the report of the committee on the constitution was carrried.

MR. J. DAVIS BARNETT read the constitution as revised by the committee (which is found at the end of this volume).

SECRETARY SINCLAIR.—My attention has just been drawn to the fact that there are two vice presidents without the rank of first and second, and then they are referred to as having the rank. I think it is a mistake that we did not observe.

MR. BARNETT.—It is an oversight on the part of the committee in writing it which I will correct. It is the intention of this report that there shall be a first and second vice president.

THE PRESIDENT.—Gentlemen, you have heard the report of your committee on the revision of the constitution; what is your pleasure in regard to it?

MR. JOHANN.—I rise to offer a resolution for the acceptance of that report. Before doing so, I simply wish to say that we have grown from infancy to manhood under a constitution that seemed to have worked very well. As a matter of course, there is not anything in existence that is perfect, and for the last few years the members have been discussing a revision of the constitution.

THE PRESIDENT.—Mr. Johann, wouldn't it be proper to make a motion to receive the constitution, and the question would then be on the adoption of the constitution?

MR. JOHANN.—I stand corrected. I therefore move that the report of the committee offering the revised constitution be accepted as a whole as read.

The motion that the report of the committee be received was carried.

THE PRESIDENT.—The question is now on the adoption of the constitution.

MR. MACKENZIE.—I move that the constitution be adopted.

THE PRESIDENT.—Mr. Johann now has the floor.

MR. JOHANN.—I have very little more to say. I was very near the end when the President corrected me. I can only say that any constitution can be lived up to, provided the members all join in holding it up. I hope the constitution as now received will be as successful as the original one.

The motion was carried unanimously.

THE PRESIDENT.—The chair will suggest now that as some committees have been appointed that would conflict somewhat with the constitution, that the vote by which those committees were ordered be reconsidered and that we start under the new constitution.

Mr. Mackenzie.—I move that we resume the regular order of business. I believe we are working under a suspension of the rules at the present time.

The President.—The gentleman's point is well taken. The regular order of business was departed from by general consent. I renew my suggestion as to the appointment of committees.

Mr. Hickey.—I move that the rules be suspended so far as to let the chair appoint the necessary committees under the new constitution.

The President.—The only point in the matter is that there have been committees appointed for the purpose of selecting places of meeting, and for the purpose of nominating officers. Under the new constitution it is necessary that that nominating committee should be appointed yesterday, which we can not do to-day, hardly; but it is necessary that five instead of three should be appointed. I ask that the former resolution appointing these committees be reconsidered and then the appointment can take effect under the constitution. I think it is a principle of American law that we can not legislate backwards.

Mr. Lauder.—I move that such action as has been taken in the appointment of these various committees as conflicts with the constitution now governing this body be rescinded.

The motion was seconded.

The President.—It has been moved and seconded that the appointment of a nominating committee and a committee to select the next place of meeting be reconsidered.

The motion was carried.

PURIFICATION OF FEED WATER.

The President.—The Chair will announce the committee very soon. The next order of business is the report of the committee on The Purification or Softening of Feed Water. That committee is Herbert Hackney, John Player and W. T. Small. The Secretary will read the report.

Secretary Sinclair.—I am advised that there is no report on that subject. Mr. Hackney and other members of the committee are engaged in some investigations that are not completed, and the chairman asked for the committee to be continued.

Mr. Sprague.—I move that the committee be continued another year.

The motion was carried.

The President.—The next order of business is the report of the committee on the Prevention of Dangerous Escape of Live Coal and Sparks from Ash Pans.

The Secretary read the report on this subject, which is as follows:

REPORT ON PREVENTION OF DANGEROUS ESCAPE OF LIVE COAL AND SPARKS FROM LOCOMOTIVE ASH PANS.

The committee on this subject submit: That for the dangerous escape of live coal and sparks from the ash pans of loco motive engines a departure is needed from present practice in the design, construction, maintenance and operation of these appurtenances.

They find that ashpans as at present constructed, in the majority of cases, are defective in design in that little attempt has been made to render them air tight, that connections and dampers are light and often insufficient to hold themselves in place, and that by reason of frailty of the material parts they soon become misshapen to such an extent as to be practically valueless either as draft regulators or for fire protection.

In construction, investigation shows that any kind of a workman is good enough to make an ash-pan. Angle irons with rivets partly driven, damper-rods and levers with punched holes and key bolts picked up at random stuck in them, very often a ½-inch bolt in a ⅞ hole, damper-doors cut away for grate shakers and eccentric straps, leaving holes for all the live coals to roll upon the tracks as they come through the grates. Hinges often riveted awry and frequently not fastened at all, just hung on and waiting for the excuse of a jolt to fall on the road. The whole affair put together in airy "bird cagey" fashion that leaves little to be wondered at that the cry is "the men will not work the dampers on the road." The entire absence of any rule as covered by question four of the committee's circular of inquiry, so far as they could learn, leaves no room for the criticism of the engineers. If mechanical superintendents and master mechanics think the matter of not sufficient importance to educate the men to, and provide facilities for the prompt and easy operation, and by reason of slovenly design and construction encourage the neglect of maintenance, it is not to be wondered at that operation exists often in the order of the "man on the right" to "get down and see if them doors is propped up" before starting his run.

The recommendation of the committee is: That for coal of a given analysis standard grates be designed and adopted. That the setting and attachments of the same be to the Association's standard as far as practicable.

That a standard ash-pan be adopted for the various types of engines; the same to be made of sheet iron with angle iron corners properly riveted and calked; that the ends be of cast-iron with cast-iron doors, the doors and frames to be machined to a tight joint, and the joint between mud ring and the ash-pan frame to be hermetically sealed and securely fastened; the rods and connections of damper doors to have pins of ample size, properly fitted, and arrangements for taking up any lost motion.

That the manner of connecting with dampers be made a standard; that the location of the handles for controlling the dampers be made a standard, and the position to be one easily accessible to either of the crew. That the men changed from one engine to another, or employed from other roads may know at once where to find them and how they are to be operated.

That the overflow from the injector be allowed to run into the ash-pan.

That sprinkling hose be attached to the discharge pipe of left injectors as permanent fixture, to provide a means of putting out the cleanings from the ash-pans where necessary to clean out the road and live coal is raked out after shaking down.

That as far as practicable hollow stay bolts be used to supply air for combustion, the damper doors to be used only for cleaning and for heavy work. The air admitted to be controlled, if desirable, by sliding dampers independent of the ash-pan connections.

That proper instruction be given all employés whose duty connect them with handling engines as to the care and management of ash-pan, dampers, grate-shakers and slash-bars.

That for engines in the same run regular points for cleaning ash-pans be established.

That stringent rules be made covering the conditions and points at which grates may be shaken and dampers opened.

That inspectors at terminals be held strictly to account for condition of ash-pan and connections, grates and water overflows. That traveling engineers test each engine and examine each engineer at some point on the road weekly instead of annually.

That section foremen be encouraged to report through division superintendent any engine that drops fire.

That tests be made by some road or roads to ascertain the value of the above, if any.

The committee have prepared blue prints (Figure 16) of the different types of ash-pans in use on a number of roads, the

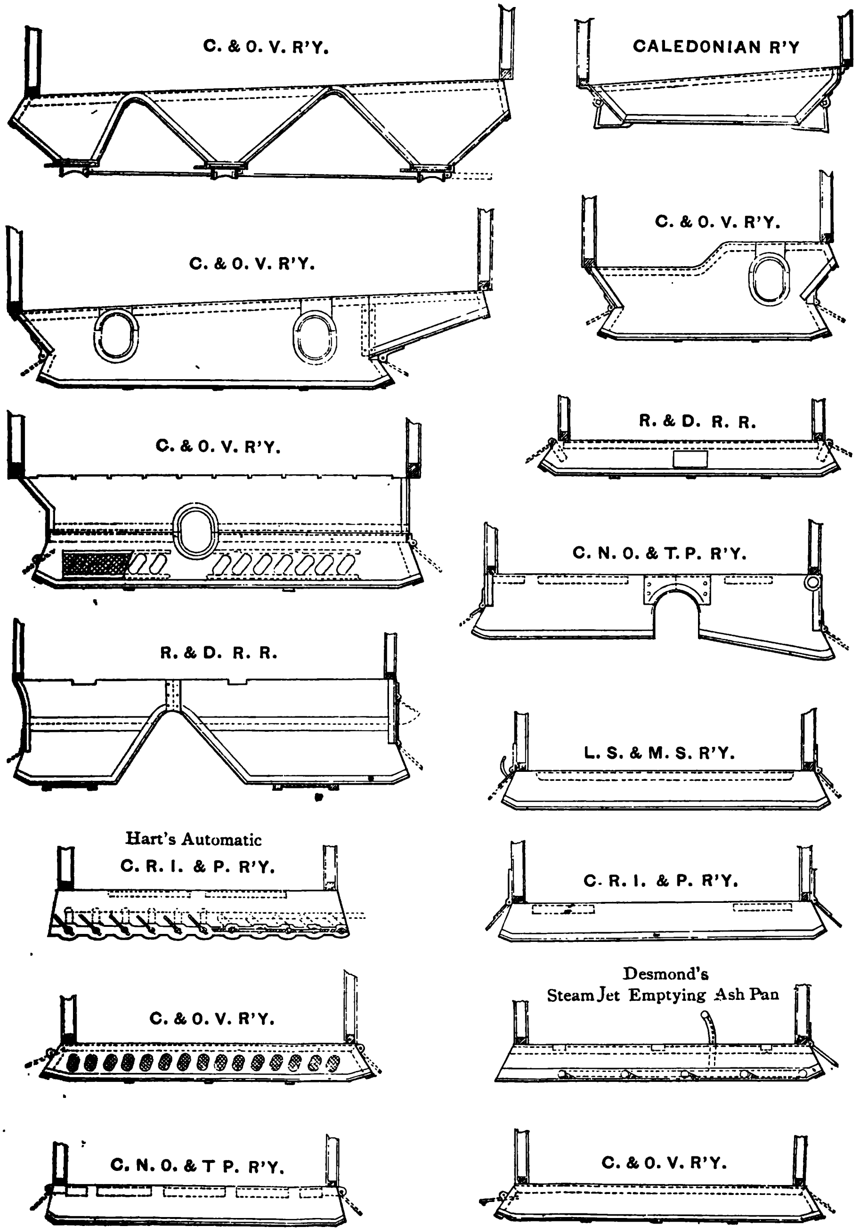

C. & O. V. R'Y.
CALEDONIAN R'Y
C. & O. V. R'Y.
C. & O. V. R'Y.
R. & D. R. R.
C. & O. V. R'Y.
C. N. O. & T. P. R'Y.
R. & D. R. R.
L. S. & M. S. R'Y.
Hart's Automatic
C. R. I. & P. R'Y.
C. R. I. & P. R'Y.
Desmond's
Steam Jet Emptying Ash Pan
C. & O. V. R'Y.
C. N. O. & T P. R'Y.
C. & O. V. R'Y.

FIG. 16.

cost of some of them is with the Secretary of the Association, not enough of the replies received having an answer to the question of cost to justify comparison in this respect. They have also added a blue print (Figure 17) of a device for automatic regulation of the amount of air admitted to the grates through the ash-pan damper doors by means of variation of the steam pressure on boiler, which while not strictly part of the subject may be of interest to the Association. A description of the working parts will be found subjoined.

Sides and bottom of pan of sheet iron with angle iron corners, ends of cast iron, doors of cast iron, ends and doors fitted, steam cylinder of extra heavy pipe with cast iron or brass ends and stuffing box, levers and connections of wrought or malleable iron.

The lower side of the single acting piston P is in communication with the steam in boiler B by means of a pipe A which may be tapped into any part of boiler most convenient, this pipe should have a globe valve in it.

The spring S in the upper half of steam cylinder is arranged to hold the damper doors D wide open when there is no pressure on boiler. A leakage hole in the flange or head H of the steam cylinder provides for the escape of any steam that may leak past the piston, and the same arrangement in the lower point of the pipe A will provide for the condense water. A graduated quadrant Q provides an independent means of locking the damper doors in any position when it is not desired to work them automatically.

In operation the quadrant lever D is disengaged and allowed to play backwards and forwards in quadrant. If boiler is cold the spring will force doors wide open at once. The valve in steam pipe is opened and as the steam rises in boiler the pressure compresses the spring and doors are gradually closed or opened as pressure varies.

In practice this machine should prevent an engine popping to a large extent, and should be a source of economy by reason of fuel saving. When desired the appliance may be arranged to

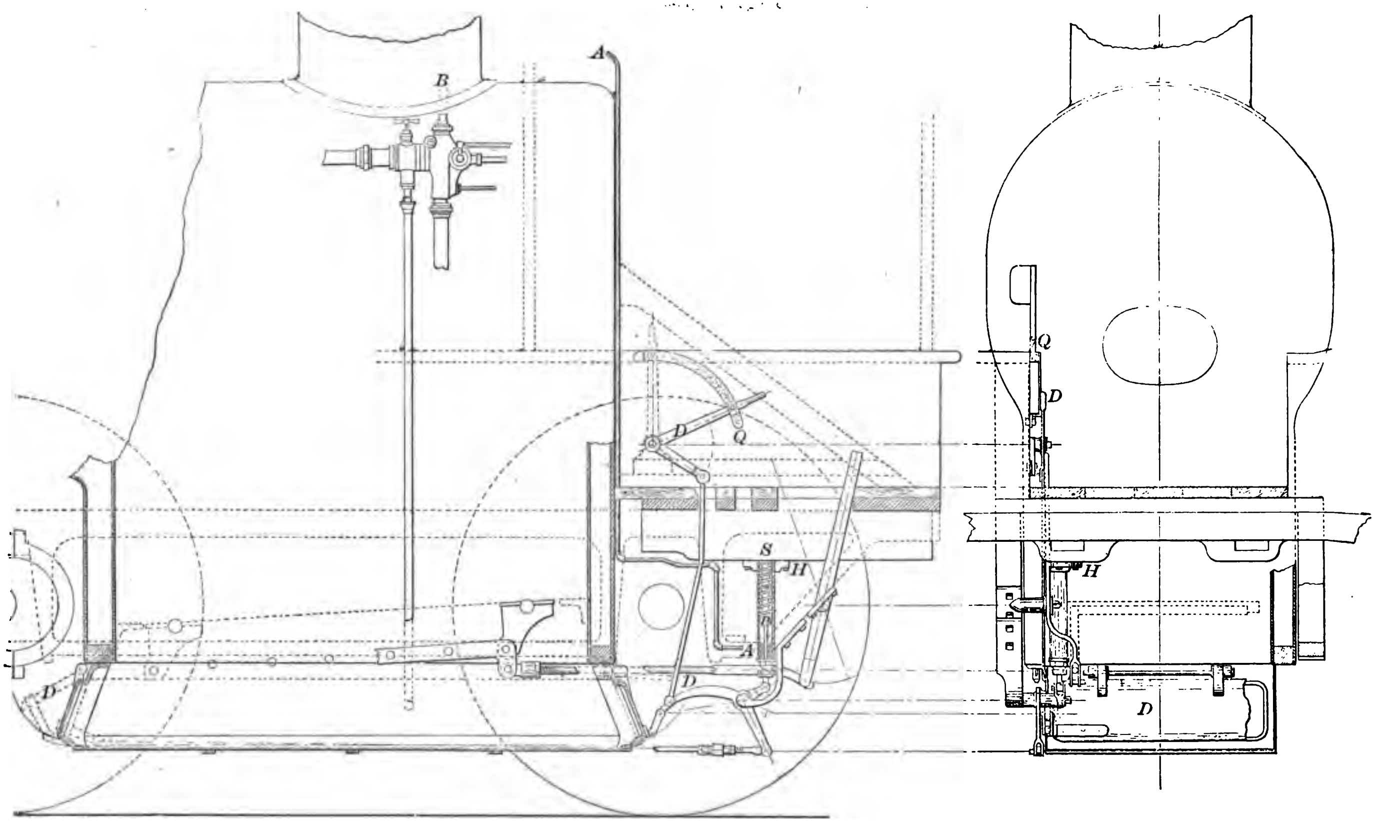


FIG. 17.

work all the dampers on the engine or by disconnecting the levers any of them can be worked independently.

G. W. ETTENGER,
E. D. ANDERSON, Committee.
W. H. THOMAS,

On motion, the report was received.

THE PRESIDENT.—If members do not desire to discuss this question, a motion to close the subject will be in order.

MR. STEVENS.—I move that the subject be closed.

The motion was carried.

THE PRESIDENT.—The next business in order is the report of the committee on tender trucks. The committee consists of E. M. Roberts, H. B. Gordon and H. D. Garrett. The report is in the hands of the Secretary, and will be read.

MR. STEVENS.—As this has already been distributed among the members, I would move that the report be passed without reading and laid open for discussion.

The motion was carried.

REPORT OF COMMITTEE ON TENDER TRUCKS.

To the American Master Mechanics' Association:

The undersigned committee on "Tender Trucks" issued the following circular of inquiry, in the usual manner:

TENDER TRUCKS.

1. Please give a description or blue print of your standard tender truck, and state if you use center and side bearings on both trucks.
2. Do you use the same truck for passenger and freight service?
3. Do you fit up your tender trucks with any more care or labor than you do your trucks for freight cars?
4. Do you run any heavy tenders in fast passenger service, and if so, have you found it necessary to design a special truck for this service?
5. If you have, please mention any points you have found defective in your ordinary truck, and your method of overcoming such defects.
6. Do you use a dust guard for your journal boxes; and if so, describe the kind giving the best results?
7. What is the size of your standard journal and axle?
8. What material do you consider the best for journal bearings?
9. What diameter and kind of wheels do you use in your

tender trucks for the different kind of service, and what diameter would you recommend for fast passenger service?

10. If you use steel tired wheels, are you troubled with flange cutting, and to what do you attribute it?

11. In using steel tired wheels, have you found that the life of the truck is lengthened, or requires less repairs because of the smoother running of the steel tires? If so, can you give any data?

12. What material do you prefer for axles, and what are your reasons for the preference?

We trust that all will respond to above queries, and contribute any other information that will be valuable to committee in compiling report on this subject.

To this we received responses from thirteen different roads:

We have concluded to report each reply received, without condensation, as follows:—

F. C. Smith, (P. D. & E. R. R.)

1. Front truck center bearing, back side bearing.

2. Yes.

3. No.

4. No.

5. Have found on rough divisions that elliptic springs in ordinary truck would not stand, replaced trucks with common freight trucks having spiral springs, and have had no further trouble on rough roads.

6. Yes—wood.

7. 3¾x7 in.

8. Brass—7. copper, 1 tin with soft babbitt filling, not over two inches wide.

9. Use 38 in. wheel; have no fast passenger trains.

10. Use cast iron wheel.

12. Prefer iron axles, because they break less than steel.

G. W. Ettenger (N. N. & M. V. R. R.)

1. Diamond truck; use both center and side bearing on both trucks. Use standard freight car truck for this purpose, 33 in. D. P. cast iron wheels.

2. Use same truck for passenger and freight.

3. No difference in the fitting except that there is a change in the springs, use spirals under freight cars and elliptics under tenders.

4. The heaviest is behind 19x24 in. express engines, 3,400 gallons water capacity; 12,000 lbs. coal is the usual load. These engines are used on express and mail trains over the mountainous portion of our road. Have not found it necessary to design any special truck for this service.

5. Have found no defects in design other than strengthening up some of the parts.

6. We use a dust guard made of Linwood. Have used vulcanized fiber; like it very well.

7. 4 in. diameter, 7 in. long.

8. Should be of the very best material; some of the improved bronzes that are on the market. However, we use ordinary car brass with good results.

9. 33 in. diameter cast iron wheels as far as possible in all service. Have nothing to recommend for fast passenger service better than wheels we are using.

10. Do not use steel-tired wheels under tenders.

11. Can give no data.

12. New hammered iron. Do not like scrap on account of dirt being likely to be found in them, and do not like steel on account of unreliability from its lack of uniformity. Have seen nothing that equals good hammered iron, made from muck bar iron carefully piled. I would further state that we use the brakes hung to the tender frames, and not to the trucks; hang the shoes well up approaching the center of the axle. We have used a large variety of tender trucks in the past years, and have tried almost everything that ever was built for this purpose, but have come back to the diamond rigid truck as the most satisfactory of all.

D. Drummond (Caledonian, Scotland)

1. We don't use trucks. Our tenders hold 3,200 gallons of water and 5 tons of coal, and are supported on steel under frames mounted on six wheels each 4 ft. in diam.

4. We use the same tender for heavy passenger and goods traffic.

6. Yes. Patent, McNee & Co., London.

7. The axles are 6½ in. diam. in middle, 7 in. diam. at wheel seat and have outside bearing 6 in. diam. and 12 in. long with centers 6 ft. 6 in. apart.

8. The composition of the journal bearings is as follows: copper 32 lbs., tin 4 lbs., spelter 2 lbs. and bush metal 92 lbs. These make up the contents of one crucible and weigh 130 lbs.

10. We are not troubled with flange cutting.

12. The material we use for tender axles is "Siemens" mild steel.

Thos. B. Twombly (C.,R.I. & P. RR.)

1. We use side bearings only on back truck.
2. Yes.
3. No.
4. Total weight of tender about 28 tons. No special for truck passenger service.
6. No.
7. 3½ x 6½ in.
8. We use common brass.
9. For passenger engines, 33 in.; for freight, from 30 down to 24 in. We have no trouble with the 33 in. wheels.
10. Have some steel tired wheels, and have been troubled a little with flange cutting, but not seriously. Attribute it mostly to trucks being out of square.
11. Can give no data.
12. Iron. I believe that there is a greater tendency to crystallization in steel than in iron, and therefore that iron is safer.

James Meehan (C.,N.O. & T.P.)

1. Center bearings on both trucks; side bearings on rear trucks only.
2. Yes.
3. No.
4. Yes.
5. The springs have found to be too light, and have strengthened accordingly, as well as the truck being strengthened generally.
6. Yes; merely a piece of wood about 6x9x5⅝ in., with 4¾-in. hole in one end.
7. Journal, 3¾x7 in.; axle, 6 ft. 11¼ in. long.
8. 6½ copper to 1 of tin.
9. 33-in. cast iron wheel.
10. Do not use them.

11. No experience.

12. I find that the best results are obtained by using a proportion of ⅔ selected scrap and ⅓ muck bar.

G. W. Stevens (L. S. & M. S.)

It is our practice to use, to a limited extent, steel tired wheels (otherwise cast iron is exclusively used) and we have no trouble with flange cutting, the size being 39 in. diameter when the spread of the truck will admit. When 36-in. wheels are used the spread must be 51 instead of 48 inches, as given in blue print.

Iron axles are used exclusively, the difference in price between iron and steel not justifying the use of the latter.

For journal bearings it is our practice to use a composition bearing in proportion of about six parts of copper to one of tin.

Francis R. F. Brown (Canadian Pacific.)

2. I use the same truck for both passenger and freight service, the only difference being in the diameter of the wheel.

3. Our tender trucks are made entirely of iron, while the freight car trucks are partly of wood and of entirely different design.

5. We run heavy tenders in fast passenger service; their capacity being 3,600 gallons, but the standard truck is all that is necessary.

6. The dust guard used in the M. C. B.

7. The tender axles are M. C. B., excepting only that they are 4¼ inches in diameter at the center.

8. For journal bearings, I use our standard passenger car brass lead lined.

9. I use 33 inch wheels cast iron "special" quality, for freight service; but in passenger service for 16 inch and 17 inch engines, 33 inch wrought iron steel tired wheels, and for 18 inch and 19 inch passenger engines 40 inch wrought iron steel tired wheels, same as we use under passenger car equipment; both the latter sizes are manufactured by Krupp.

10. We do use steel tired wheels, and no trouble with flange cutting; but where such occurs would say that it arises from defective building.

11. I prefer steel for axles because it is cheaper and better.

T. W. Gentry (R. & D.)

1. We use a strictly center bearing truck; with side bearings or rubber on back truck.

2. We use same truck for passenger and freight service.

3. We exercise a more rigid inspection of parts of new tender trucks, and select best journals, etc., for this service.

4. We run three thousand (3,000) gallon tenders: capacity six (6) tons coal; and have found it necessary to design the truck shown by blue print.

5. Our former tender truck, was the ordinary Thielson pattern, iron channel transoms, with iron end pieces, and swing bolsters. We had trouble keeping rivets tight, and found the bolster hangers—which were solid welded links of 1¼x1 inch iron—were too light and broke. We then made rigid bolster truck.

6. We use a simple dust guard made of wood, which is fitted in a suitable recess provided in oil box, and gives good results.

7. Our standard tender truck axle has 8x4 in. bearing journal, is 5 in. at wheel seat, and 4⅜ in. in center; and is same as our 60,000 pound freight car axle.

8. We use and get excellent results from solid bearings made in our foundry of composition—100 lbs. lake copper, 14½ lbs. Banca tin, 2 lbs. pig lead. This is used on tender and passenger car trucks only. We use solid bearings composed of 65 lbs. old bearings, 35 lbs. copper, 5 lbs. tin, 2 lbs. lead, for freight cars. I believe, however, the best journal bearing for general service is a good solid composition, lead lined.

9. We use 33-in. steel-tired wheels in passenger, and 33-in. cast iron wheels in freight service, under our tenders. My experience with wheels over 33 in. in diameter is limited, but I am not favorably impressed with the 42-in. wheel.

10. We are troubled to some extent by flanges of steel-tired wheels cutting away. We attribute it to the action of rails upon the soft and malleable tire, and make a practice of truing up and sizing wheel as soon as they show evidence of unequal wear; in other words, we do not allow them to injure flanges by running too long between turnings.

11. We find the nuts and split keys, hanger and cellar bolts, and all parts of trucks with steel wheels are kept tight with less

work than with cast iron wheels, and think the life of truck lengthened by their use.

12. I prefer good muck bar iron axles, and consider any first-class reliable axle as safer than the ordinary steel axle. Under ordinary conditions, journals of iron give less trouble from heating, and when roughened from heating wear smooth sooner than steel. However, my experience with steel axles is not very extensive.

Wm. Swanston (C., St. L. & P.)

1. We use the Pennsylvania Railroad freight truck (standard) under all our tenders.

2. We use the same truck in passenger, freight and switching service.

3. We do not use any more care with tender trucks than we do with freight car trucks when fitting up new, but they are subject to closer inspection when in service than it is possible to give to freight cars.

4. We run 2,800 gallon cisterns on diamond freight trucks with the standard axle for 40,000 lbs. capacity cars, but for larger tenders we use the 60,000 capacity axle and the iron freight truck.

6. 7. We do not use dust guards with our axles for 40,000 lbs. capacity, but we use a vulcanized fiber guard with the 60,000 lbs. capacity axle. The former has a journal 7 in. x 3¾ in., the journal of the latter is 8 in. x 4 in.

8. I have found the best results from brass with a soft metal lining about 1-16 in. thick to start with.

9. We use 33 in. wheels in our tenders for all kinds of service. I think, however, that it would be an improvement to use 36 in. for passenger service.

10. We have not used steel-tired wheels under tenders.

12. My preference is for iron axle, and my reasons for this preference is that I have had better success with iron than with steel, having fewer hot boxes and the journal boxes do not wear out so fast.

Clem Hackney (U.P.)

1. We use side bearings only on hind truck.

2. Yes.

3. Just about the same.

4. Our standard tender carries 2,900 gallons of water and 10 tons of coal Trucks as per blue print takes care of this load on all our trains.

5. We have no trouble with this truck.

6. Dust guards of white wood with leather tacked on face.

7. 3⅓ x 7 M.C.B. Axle.

8. The following is our specification for tender journal bearings: to be of new metal, composed of one part tin and eight parts ingot copper, covered on bearing side about 3-32 in thick with fine babbitt as follows:

87.4 parts tin,
4.2 parts copper,
8.4 parts antimony.
100

9. We use steel tired and cast iron wheels, prefer 33 in. diameter for all classes of service.

10. We are more troubled with flange cutting on steel tired than on cast iron wheels, and attribute same to the difference in character of flange of the steel tire and that of the cast iron wheel.

11. Have found no material difference.

12. We have a large number of Otis steel axles in service; they are giving good satisfaction. We are making our own axles now from assorted scrap. If we were going outside to purchase I would prefer mild steel.

John Mackenzie (N. Y. C. & St. L.)

1. We use center bearing on our standard truck.

2. No.

3. No.

4. No.

5. No.

6. We use a common board placed in the aperture in rear of box with a hole cut to fit the axle neatly.

7. 4¾x8⅜ in. journal, 5 in. wheel fit, 4⅜ in. center, 6 ft. 3 in. center to center of journal, 6 ft. 11 in. over all.

8. Copper and tin 7½ to 1.

9. 33 in. chilled wheel weighing 560 lbs.

10. We use a few steel tired wheels, have had some trouble with flange cutting; we attribute the cause to the quality of metal.

11. We have found no difference.

12. We prefer steel; because less liable to breakage.

John Player (Wisconsin Central.)

1. The standard truck of this road is known as the Schenectady patent, and we are using side bearings on both the trucks.

2. We use same truck for both freight and passenger service.

3. We fit all trucks for running either under freight cars or under tenders very carefully in order to have them run good.

4. Our tenders are heavy, capacity for water 3,500 gallons; capacity for coal six tons.

5. Have found no defective points except the springs, and remedied that by adding two leaves to the spring.

6. Are using M. C. B. journal box with dust guards complete.

7. Journal and axle are M. C. B.

8. Consider brass lined with soft babbit the best journal bearing in use.

9. Are using 33 in. cast chilled wheels in tender trucks both freight and passenger, for very fast passenger service would recommend 36 in. steel tired wheel.

10. Have no steel tired wheels under tenders, using steel tired wheels under engine trucks, have found no trouble from flange cutting.

11. Have not noticed any material difference in life of truck using different kind of wheels.

12. Prefer to use hammered iron axles, for the reason that my experience with steel axles was not satisfactory, having several break in service. Would not say steel axles are not reliable, but from my experience would prefer iron till I have more reliable data relating to steel.

Your committee fails of doing the duty it should, and the Association is deprived of much valuable information owing to the failure of the members to respond to our circular of inquiry. The few replies are valuable in themselves, as they show good designs and construction fully meeting the modern requirements for high speed and capacious tenders, yet with so few roads to give us their practice we are unable to make any comparisons, or do more than give in full the views of these gentlemen as they have presented it to us, and we think with their views and practice so clearly presented, nothing is left for your committee to say further on the subject, unless we ask that the drawings of trucks furnished be illustrated in the Association reports, if the expense for same can be afforded consistently.

E. M. ROBERTS,
H. L. GARRETT, } Committee.
H. D. GORDON,

DISCUSSION ON TENDER TRUCKS.

THE PRESIDENT.—The subject is now before you for discussion.

MR. H. B. GORDON, Philadelphia, Wilmington & Baltimore.—As one of the members of the committee, I would like to say that I am somewhat disappointed in regard to the amount of information we got in answer to the circulars of inquiry. Your committee was of the opinion that it was almost the universal custom amongst the master mechanics to use for their tender trucks practically the same truck as is used in freight cars. This is usually some form of diamond bar truck, and has made a very good truck. During the past few years the demand for heavy engines and large boilers to make fast time has called for an increase in the size of the tenders, so that they now carry very large loads, almost equal in some cases to our heavy freight cars. We all know that it is found that the old truck is not sufficient to carry the new heavy cars, and it was felt that possibly with these large tenders it might be found that the old trucks would also prove defective or not sufficiently strong, and the questions were framed somewhat with the view of bringing out the information which any of the members might have, and get their experience as far as possible of any new truck they might design to carry the larger, heavier tenders in fast passenger service. The replies which were received were very few, not sufficient to enable us to form any definite conclusions or to make a very interesting report.

There is also another matter in connection with this tender truck business, in respect to which I would like to have seen more responses to the inquiries, and that is in regard to steel tired wheels. Of late years there have been a great many steel tired wheels in tender trucks, and my experience with steel tired wheels has been that they are a smoother running wheel, and the trucks do not require so much repairs with the use of the steel tired wheels as they do with the chilled wheels; but my experience has also been, that steel tired wheels very rarely wear to such an extent that they require to be turned because of the wear of the tread, but are usually taken out because of the cut flange. I have talked with a good many who have had experience with them. Some say they have had no trouble with flange cutting; others have been troubled very much. I thought we might be able to get some information on this point, as to what was the cause of this flange wear, and might be able to suggest some means of preventing it. As I say, the information we got was not sufficient to enable us to make any recommendation whatever. I should like to hear the subject discussed. I think it is of a good deal of interest.

MR. SINCLAIR.—There is one point about tender trucks that I think might have been taken up; that is swing beam trucks for tenders. There is a diversity of practice in that respect and there is either a right or a wrong practice. It is either right or wrong to have swing trucks for tenders, and I believe that an expression of the members on that matter would be of importance and of interest.

MR. MACKENZIE.—I would like to ask if there are any members who have tried the changing of sharp flanges, taking wheels that run to the flange, pulling them off, and mating them with another wheel that also runs to the flange. We have commenced doing that, and we think with good results. In that way we think we get the nature of the metal nearer alike in the two wheels. I have taken wheels out and turned them continually. Of course, if we turn them in the shop we know they are of a size. It has demonstrated itself to quite some extent with us, that that has a great deal to do with it.

THE PRESIDENT.—Is there any gentleman present who can answer Mr. Mackenzie's question.

MR. GORDON.—I will state that I tried the same thing that Mr. Mackenzie speaks of, with very good results. Where there were two wheels with flanges cut about the same, I have taken them off and put the two sharp flanges together and the two good flanges, and watched those wheels, and while I did not keep a mileage, I found they did very much better than before : but I think in mating your wheels it will not do to take a flange that is not cut badly and put it with a flange that is cut very badly. You want to take flanges that are cut about the same. My idea was that flange cutting was caused a good deal by the difference in the density of the tires, and when you get two tires of the same density together and the same degree of hardness, you get better wear.

MR. T. W. GENTRY.—I believe what Mr. Mackenzie has suggested is very generally the difficulty in the way of matching and mating the wheels. We do it to a considerable extent, but we cannot adopt it as a practice from the simple fact that it is a difficult thing to match two wheels exactly. Sometimes when we want to do it at once, we have not a second wheel that will mate. We ought to have probably some better means than that, but that is a very good way.

MR. MACKENZIE.—It is not our practice to take a tire that is two inches thick and mate it with a tire an inch and a half thick, but if we find them within a quarter of an inch we turn them. They ought to be turned anyway, to restore the flange. In that way we start them out in good shape and we can very soon demonstrate whether there is anything in it or not.

THE PRESIDENT.—Is there any further discussion to be had on this subject?

MR. JOHANN.—I move that it be closed.

The motion was carried.

APPOINTMENT OF COMMITTEES.

THE PRESIDENT.—The chair will take this opportunity to appoint the committees under the constitution. As a nominating committee I appoint J. N Lauder, J. Davis Barnett, George Hackney, J. F. Divine and J. M. Boon.

The committee on the next place of meeting will be John Mackenzie, O. Stewart and T. W. Gentry.

DISCUSSION ON SELECTION OF NEXT PLACE OF MEETING.

The committee on selecting the next place of meeting are to report, under the new constitution, three places. One of these places must be selected by ballot by the Executive Committee at some time within six months.

MR. LAUDER.—As one of the committee on the constitution, my recollection is that the committee can report as many places as they please. Am I right? But after voting, the three receiving the highest number shall be taken by the executive committee.

THE PRESIDENT.—The constitution says: " Places for holding the annual convention may be proposed at any regular meeting of the Association before the final adjournment. The places proposed shall be submitted to a vote of the members, and within six months thereafter the executive committee should select a place from the three." I stand corrected.

MR. MACKENZIE.—Is it necessary to appoint a committee, Mr. President? I do not so understand the constitution. I understand that these names shall be presented by the members, and that the three receiving the highest number will be the ones to be selected from by the executive committee.

MR. LAUDER.—I think, Mr. Chairman, you are right in this matter. While it does not specifically say how these propositions shall be made, it seems to me that our custom has determined that, and it would be well to have a committee. I see no objections to having a committee.

THE PRESIDENT.—The next business in order is the report from the committee on Traction Increasers, in connection with Over-cylindered Engines. That committee consists of J. Davis Barnett, F. L. Wanklyn and T. J. Hatswell. The report is in the hands of the Secretary.

The report of this committee was read by J. Davis Barnett, and is as follows:

REPORT ON TRACTION INCREASERS IN CONNECTION WITH OVER-CYLINDERED ENGINES.

Only ten replies were received to your committee's circular of enquiry (a copy of which is attached as an appendix to this report) viz: From G. W. Ettenger, Newport News & Mississippi Valley Ry. (A); J. McGrayel, Des Moines & Fort Dodge Ry. (B); W. J. Robertson, Central Vermont Railroad (C); G. W. Stevens, Lake Shore & Michigan Southern Ry. (D); T. B. Twombly, Chicago, Rock Island & Pacific Ry. (E); F. L. Wanklyn, Grand Trunk Ry. (F); W. Swanston, Chicago, St. Louis & Pittsburgh Ry. (G); T. W. Gentry, Richmond & Danville Ry. (H); J. Johann, Texas & Pacific Ry. (J); and Clem Hackney, Union Pacific Ry. (K). And to avoid constant repetition of names in summarizing the statements, they will be referred to by the bracketted initial letter following the name.

To the query "Can the defect of an over-cylindered engine be best remedied by the application of a Traction Increaser?" all give an emphatic negative.

(A), (J) and (K) would prefer either bushing the cylinder or adding dead weight; (B) and (G) say the best and least expensive method to correct the difficulty, would be to bush the cylinders, and (G), (H) and (J) say that for this purpose cast iron is as good as steel; (C) would prefer any one of the three other suggestions rather than use a Traction Increaser; whereas (E) and (H) prefer dead weight distributed over the driving wheel, "because there is no additional mechanism, and with a permanent load the springs can be adjusted to suit. The additional power required to haul this dead weight, is almost nothing, and as the old iron will credit nearly as much at the scrap pile as it cost at the foundry, the total expense will be very little." *

In answer to the query "Would you use Traction Increaser on six, eight or ten wheel coupled engines?" (A), (G), (J) and (K) say, if used at all, would use on all classes; (E) sees no good reason why, if needed, they should not be applied to almost any type of engine; and (C), (D) and (H) say they do not recommend their use on any class.

If with a Traction Increaser applied, would they then dispense with the use of sand? All answer "No." (A), (C) and (H) reply that a Traction Increaser would practically lengthen the engine wheel base; (D) says the freedom of movement between tank and engine is destroyed; and (G) says there is no doubt that its application increases the locomotive resistance on curves.

*(For a clear statement showing the slight cost per annum in hauling the extra dead weight of (say) five tons, added to the locomotive itself, see an editorial in "The Master Mechanic," March, 1887, p. 33. With coal at $3.00 per ton, and a mileage of 5,000 per month, the additional cost is shown to be about $2.65 per month.)

(J) thinks some types would have that tendency and others would not, but has no personal experience ; and (K) says "No," but is also without experience.

No member outside your committee making reply to the circular, has an engine equipped with a Traction Increaser, and the committee not having had time or opportunity to carry out a trial, can not say from direct experiment if the locomotive resistance moving over a curve, is increased when a Traction Increaser is in operation.

In answer to question No. 5, (A), (C), (E) and (H) reply that if used at all, they would use them continuously, and (K) does not see why they might not be beneficial on bad rail; but (J) does not think it desirable, because, if so used, there would be no reserve of power in an emergency.

In reply to No. 6, (A), (C), (E) and (K), say they see no reason why they should not be useful at high as well as at low speed; (H) believes their use at high speeds would be attended with more danger ; and (J), while seeing no reason why they should not be useful at high speeds, thinks there would be great strain on the machinery as well as rapid wear.

No member replying is familiar with any other form of Traction Increaser than those known as "Dees," "Purves," "Craven" (automatic traction drawbar) and "The Locomotive Improvement Coys"; but the press credit J. McKenna, I. D. & S. Ry., with an experiment that utilizes an ejector to exhaust air from a shallow cylinder covered by a diaphragm that is connected by bell crank with the tender.

The single replies to queries 8 and 9 are by (F,) a member of your committee who says. "The only experience the Grand Trunk Railway have had of an engine fitted with a Traction Increaser is No. 172, Manchester build, ordinary American type, four wheels coupled, 17″x24″ cylinders, 5′ 3″ driving wheels, boiler pressure 135 lbs., total weight of engine 71,060 lbs., distributed as follows :

On truck	27,130 lbs.
On drivers	23,130 "
On trailers	20,800 "

The Traction Increaser was guaranteed to enable the engine to haul 33 per cent. greater load than formerly.

In one experiment I rode on the engine myself. She hauled behind her 18 loaded and 22 empty cars including the van, the usual load being 23 loaded cars.

The engine hauled the load up the controlling grades of the division, but straining itself to such an extent that I was convinced that a Traction Increaser would soon send the engine into repair shop, and the results have shown that my conclusions were not unfounded.

"The Traction Increaser was applied in October '86, the engine at that time being in good order. In January '87, after having run 11,000 miles with the Traction Increaser, hauling heavy loads, the engine came into repair shop with a broken main frame, two broken horn blocks, broken saddle casting, broken right driving crank pin, and broken cylinders. The fractures in the latter were close to the flange through which they are bolted to the saddle casting. These repairs were executed, and the use of the Traction Increaser continued with a somewhat lightened car load. The following April the engine was returned to repair shop after having run 4,250 additional miles, for a new axle and new right driving crank pin. It will thus be seen that the engine was severely damaged after having run but 15,250 miles with a Traction Increaser. The Traction Increaser remains on engine No. 172, but instructions have been issued not to haul more than the average load for engines of that class, and we have since then had no special trouble."

In reply to query No. 9, (F) can not give any definite information, as the expense of putting the appliance on was borne by the inventor. He thinks it should not exceed $100 after the patterns were made. He considers the adoption of a Traction Increaser a great mistake, and (J) also says that his experience will not warrant any expenditure of time or money in further experiments with them.

J. DAVIS BARNETT,
F. L. WANKLYN.

On motion the report was received.

DISCUSSION ON TRACTION INCREASERS.

Mr. J. Davis Barnett.—After the philippic of our energetic friend, Mr. Lauder, I think some explanation or apology is due to the convention for the form in which this report is made. When it was written out but five replies were received, after which additional replies were received, and the document was not put into the printer's hands by the Secretary; it was held in abeyance, and the committee endeavored to combine five additional replies, that came in very late, into the body of the report. Hence it is somewhat more disconnected than it was in its original form. The committee very much regret that none of the members who desire the continuation of this committee sat on the committee, and they much more regret that those who were anxious to have it continued did not reply to the circular of inquiry. Such neglect on the part of our members is very discouraging to a committee and robs them of any enthusiasm they might possess on any particular subject. Of course the report is unanimous that traction increasers are no good, and unless the members present are willing to give on the floor of the house more information than they were willing to give the committee, there will be very little opportunity for discussion. I think the matter should be discussed. The replies to last year's committee on cylinder capacity showed that some of us had very different opinions as to what amount of tractive adhesion any particular engine has. I mean by that, what percentage of the total weight coming on to the driving wheels should be utilized for adhesion, and most of the replies to the committee on cylinder capacity vary, due to the fact that none of us agree as to what percentage of the weight coming on to the driver we could actually utilize for purposes of adhesion. It would be very well if we could increase the percentage we now have, whatever that may be, and I do not know where we shall look for it. The report says we cannot look for it in traction increasers. We are not likely to have a third, central rail. There is no practical limit to the adhesion on horizontal wheels pressed by lever or spring or any other force. We are not likely to have that. Electricity has been tried. Experiments have been carried out in that direction covering the last 35 years, with very little success indeed. I do not know that we are a step further to-day in the direction of increasing traction by electricity than we were 35 years ago. Of course you have got to turn a wheel practically into a north or south pole. You cannot change the polarity of any mass suddenly, when you cut off the circuit. There still remains a small amount of magnetism in the wheel. It will not change its polarity suddenly, and therefore with your wheel continuously revolving there is a confusion of the north and south poles so that the adhesion that the wheel would seem to have to the rail while standing is lost when you get your wheel revolving. The very best experiments in this direction—and some most elaborate and costly ones have been carried out—give a continual adhesion of but one-twelfth of what the locomotive had without this equipment, and the equipment so far tried is very often a difficult thing to attach to a locomotive. I believe there are some inventions out quite recently, and from the way they are advertised I infer that the inventors have not made themselves familiar with the experiments that have been carried out, more particularly on the European continent. I think the conclusion we can come to in this matter is, that a few handfuls of sand are really more effective than anything else we are at present familiar with. Sand, of course, is delivered very unequally, as it is delivered from our ordinary sand boxes, and hence the experiments that are being carried on all around us to see if the delivery of sand cannot be adjusted somewhat, so that only that amount of sand absolutely required shall be delivered and just at the point where it is required, and there shall be just enough to utilize the adhesion of the drivers without increasing the haulage resistance of the train. I do not know what experiments are being carried on on this continent, but your committee sent a circular to England and an apparatus which is being used there with success is shown in the tracing on the wall. That is an apparatus for delivering sand by a steam jet; not a steam jet direct, understand, for that is more or less liable to the same trouble we experience at present of an unequal delivery of sand—that is, an inability to control the amount so that you can just deliver the minimum required on the rail. The more modern patents have a steam jet which, by air suction, lifts the dry sand up. Therefore you can so control it that a very small amount can be lifted and delivered right in between the rail and the wheel, quite close. I do not know of any other means of so evenly controlling the sand as a steam jet, that shall induce a current of air which, by its action, lifts the dry sand up and carries it forward.

MR. JACOB JOHANN. — I am somewhat disappointed that the friends of the traction increaser did not sail in a little livelier, and have this matter brought up in proper shape this year. We had a little discussion on it last year, and several of the members expressed their opinion quite freely on the subject, and brother Lauder and myself got quite an advertisement over the matter, which I do not think hurt us particularly, since I see by the report of the committee that we are entirely justified, and the party issuing that circular is confounded —— that is all. The report meets with my entire approbation, and I think it is correct. I think, as a matter of fact, that the only way to get a traction increaser is to get a properly proportioned engine; that is, we want our locomotives to be proportioned in such a way and to have them work in such a way, as not to push them to their ultimate power continually. They should always have a reserve of power in case of emergency, so that when they get into a tight place they can pull out of it, and no amount of traction increasers that you could put on would help in that matter, except in that way the report speaks of, breaking frames and distorting the engine generally. My opinion is, after some time spent in looking into that matter, that a traction increaser is of no benefit to a locomotive.

MR. SPRAGUE. — I move that the discussion on this paper be closed.

The motion was carried.

THE PRESIDENT. — The next report in order is The Magnetic Influence of Iron and Steel in Locomotives on the Watches of Engine runners. The committee consists of James Meehan, Harvey Middleton, and T. W. Gentry.

REPORT ON MAGNETIC INFLUENCE OF IRON AND STEEL IN LOCOMOTIVES ON THE WATCHES OF ENGINE RUNNERS.

This report was read by the secretary, and is as follows :

From the information before us, which is somewhat limited by reason of the failure of many to whom circulars were issued to respond, we are of the opinion that more or less magnetic influence is brought to bear on the watches of men running and employed about engines, and that the protector designed by Mr. C. K. Giles, of Chicago, has considerable merit in offsetting this detrimental influence. It appears to be general that this view of the cause of the irregular running of watches has not been considered, and while it is not denied that magnetic influence exists, it is left an open question by reason of a lack of study and experience.

From the reports at hand it is conceded that a variation is observable in the running of watches on and off an engine, but the cause is assigned to the irregular motion of the engine acting on the balance wheel. This opinion was held by us who have run locomotive engines, such variation being noticed even in the finest grades of American and Swiss watches, and our views were not altered until recently listening to a lecture on the subject, delivered by Mr. Giles, who thoroughly demonstrated the trouble to be due to magnetism.

We are much impressed with the necessity of railroad employes having good time pieces, and any research, discussion or mechanical improvement that will lead to increasing the utility of the watch in this direction will meet our approval and support, as it will benefit all of us generally, and tend to do away with the repetition of awkward occurrences which we have noticed on railroads by reason of variation in watches. Believing that a demonstration of the effect of magnetism on watches would be of much interest and profit to all, we would recommend that Mr. Giles, who has made a special study of the subject, be requested to address the Association thereon.

JAMES MEEHAN,
HARVEY MIDDLETON, } Committee.
T. W. GENTRY,

DISCUSSION ON MAGNETIC INFLUENCE ON WATCHES.

SECRETARY SINCLAIR.—There was also added a note to this report, saying that a great deal of correspondence had been sent to the Secretary, and requesting him to tell the Association what was in it. The report came to me a few days before I had to leave for the previous convention, and in the first place it is not the business of the Secretary to digest correspondence to make up reports, and I had not the time to do it if I was anxious to do it, and the matter has been left over. I have the pile of correspondence here, and if any one wishes to examine it he is welcome to do so. There was a great deal of information sent by Mr. L. R. Johnson, of the Canadian Pacific. He gave circulars to his engine men to report on the variation of watches, and he sent in a great many circulars stating his views. There was no time to digest these things and put them in proper shape.

MR. SPRAGUE.—I move that the report be received.

The motion was seconded.

MR. T. W. GENTRY, Richmond & Danville.—I was going to suggest that some one of the members make a motion that that committee be continued for another year. It is possible that there will be developments between now and our next meeting that we will like to handle. I am satisfied that the report is not satisfactory to the committee, much less to the members of the Association. Mr. Meehan, as you are aware, had the misfortune to have his shops burned, which kept him so much engaged that in a letter I received from him just before I left home, he said he was almost ashamed to present the report in its present shape, and he didn't look upon it as a report; and while I am not authorized to ask that the committee be continued at all, I would like to see the committee continued. I do not care to make a motion.

MR. STEVENS.—That rather changes the face of the matter. My intention was to have the report accepted and referred to the Executive Committee. We are now starting off on a new constitution and do not want to establish any bad precedents in allowing this, that or the other man to address the convention unless he come through the proper channel, but I am perfectly willing and would move that the committee be continued for an other year.

The motion was seconded.

The motion to accept the report and continue the committee for another year was carried.

APPOINTMENT OF COMMITTEE ON SUBJECTS FOR DISCUSSION.

THE PRESIDENT.—The chair will take the opportunity at this time to re-appoint the committee on subjects. The committee on subjects for this and for next year will be John Player, George Hackney and T. W. Gentry. The committee will bear in mind that we shall have to have a report from them before this session closes.

The next business in order, is the report of the committee on Matters

Relating to Chilled Car-wheels. The committee was appointed to confer with committees of the Master Car Builders' Association and the Wheel Makers' Association and is composed of J. N. Lauder, George W. Stevens and James Meehan. The report of this committee was read by Mr. Lauder and is as follows:

REPORT ON CAST IRON WHEELS.

Your committee appointed at the annual meeting of the Association, held at St. Paul, Minn., in June, 1887, to confer with a like committee of the Master Car Builders' Association and the executive committee of the Association of Manufacturers of chilled car wheels, on the specifications, tests and guarantee of cast iron wheels, would submit the following report :—

The several committees have held three conferences during the year, and have carefully considered the subject of chilled wheels, in the matters of specifications, tests and service guarantee, and have agreed to recommend to their several Associations the following

SPECIFICATIONS FOR CAST IRON WHEELS.

1. The chills in which the wheels of any one wheel maker are cast shall be of equal diameters, and the same chill must not vary at different points more than one-sixteenth of an inch in diameter.

2. There shall not be a variation of more than one-half inch in the circumference of any given number of wheels of the same nominal diameter, furnished by any one maker, and the same wheel must not vary more than one-sixteenth of an inch in diameter. The body of the wheel must be smooth and free from slag or blow holes. The tread must be free from deep and irregular wrinkles, slag, chill cracks and sweat or beads in the throat which are one-eighth of an inch or over in diameter, or which occur in clusters of more than six inches in length.

3. The wheels broken must show clean, gray iron in the plates; the depth of pure white iron must not exceed seven-eighths of an inch or be less than three-eighths of an inch in middle of the tread, and shall not be less than three-sixteenths of an inch in the throat. The depth of the white iron shall not vary more than one-fourth of an inch around the tread on the rail line in the same wheel.

4. Wheels shall not vary from the specified weight more than two per cent.

5. The flange shall not vary in the same wheel more than three thirty-seconds of an inch from its mean thickness.

6. The single plate part of a 33 inch wheel, known as the Washburn pattern, shall not be less than five-eighths of an inch in thickness in a wheel weighing from 550 to 575 pounds, and not less than three-fourths of an inch in thickness in a wheel weighing from 575 to 600 pounds.

TESTS FOR CAST IRON WHEELS.

1. For each hundred wheels which pass inspection and are ready for shipment, one representative wheel shall be taken at random and subjected to the following test :—

The wheel shall be placed flange downward on an anvil block weighing seventeen hundred (1,700) pounds, set on rubble masonry at least two feet deep, and having three supports not more than five inches wide for the wheel to rest upon. It shall be struck centrally on the hub by a weight of one hundred and forty (140) pounds, falling from a height of twelve (12) feet. Should this wheel stand five (5) blows without breaking into two or more pieces, the hundred wheels shall be accepted. Or, wheels must be of such strength that 550 to 575 pound wheels shall require twenty (20) blows, and 575 to 600 pound wheels shall require thirty (30) blows of a hundred (100) pound drop falling seven feet on the plate close to the rim to break a piece out—the wheel resting upon a cast iron plate weighing not less than one thousand (1,000) pounds.

2. Should in either case the test wheel break into two or more pieces with less than the required number of blows, then a second wheel shall be taken from the same lot and similarly tested. If the second wheel stands the test, it shall be optional with the inspector whether he shall test a third wheel or not. If he does not so elect,—or if he does and the third wheel stands the test, the hundred wheels shall be accepted.

3. The above tests shall apply to standard weight wheels from 26 inches to 42 inches diameter, used on standard gauge roads.

FORM OF CONTRACT.

THIS INDENTURE, made this day of 18— between party of the first part, and party of the second part, WITNESSETH :

1. The party of the first part hereby agrees to furnish to the party of the second part, free on board cars at chilled cast iron wheels, inches in diameter under the following conditions.

2. The party of the second part hereby agrees to pay to the party of the first part dollars for each wheel furnished, and to keep an accurate record of the mileage made by the wheels placed in service under cars in passenger equipment and under locomotives and tenders, and an accurate record of the number of months of service of the wheels placed under cars in freight equipment.

3. The party of the second part hereby agrees when any wheel furnished under this contract is scrapped, to furnish to the party of the first part a statement which will show

1.— The wheel number.
2.— The service in which the wheel ran.
3.— The amount of service in months or miles.
4.— The cause of failure.
5.— A charge against the party of the first part of fifty-five per cent (55%) of the price of the wheel mentioned above.
6.— A credit to the party of the first part of

----cents per 1000 miles for 36 in. passenger equipment
---- " " " " " 33 " " "
---- " " " " " 30 " " "
---- " " " " " 36 " locomotives and tenders
---- " " " " " 33 " " " "
---- " " " " " 30 " " " "
---- " " " " " 28 " " " "
---- " " " " " 26 " " " "
---- " " month " 36 " freight equipment
---- " " " " 33 " " "
---- " " " " 30 " " "

except in the case of wheels made flat by sliding, or removal for sharp flanges or other unfair treatment, which have not made sufficient service to balance the charge against the party of the first part as above ; in such case a service credit shall be made which shall balance the charge.

4. The party of the first part hereby agrees that on presentation of the statement to pay to the party of the second part any balance due from lack of sufficient service on the part of the wheels (with above exceptions) to balance the charge ; and the party of the second part hereby agrees to pay to the party of the first part any balance due as shown by the aforesaid statement, — settlements to be made quarterly. It is, however, understood and agreed that no credit shall be allowed for excessive mileage for time service on freight wheels beyond the time guaranteed.

5. The party of the second part hereby agrees to hold subject to the inspection of the party of the first part, for a period of thirty days after the said statement has been rendered, any wheels (with above exceptions) which have not earned for themselves a credit equal to the amount charged against them.

SERVICE GUARANTEE.

36 inch passenger wheels	70,000 miles
33 “ “ “	60,000 “
36 “ engine and tender wheels	60,000 “
33 “ “ “ “ “	50,000 “
30 “ “ “ “ “	45,000 “
26 and 28 inch engine and tender wheels	40,000 “
Refrigerator, through line and cattle cars	24 months.
All other freight cars	48 “

Settlements of claims for non-performance of guaranteed service, shall be made upon the basis of mileage and time guarantee as above.

JAMES N. LAUDER,
GEO. W. STEVENS, } Committee.
JAMES MEEHAN,

DISCUSSION ON CAST IRON WHEELS.

MR. SPRAGUE.—I move that the report be accepted.

The motion was carried.

THE PRESIDENT.—The subject is now before you for discussion. I would say to the members that as we have got well along with our business this morning we have more time than we expected, so that any one who feels like discussing this question will have ample opportunity.

MR. J. N. LAUDER.—As one of the committee that agreed to the report just read, I would like to make a few remarks on this question. In the first place, I would like to say that I am extremely anxious that this Association should pass upon this question, either for it or against it. I understand that the master car-builders have laid it over—that is, they have taken no action for or against it. Now, the object of the meetings and conferences held the past year by the various committees was mainly to devise some method whereby the wheel-makers could be stimulated to improve the quality of the old cast iron wheel. Under the present system of buying and contracting for wheels, it places the honest and reliable wheel-maker—the wheel-maker who means to make a good, substantial, safe wheel—it places him in a very embarrassing position, because, as a rule, the railroads of this country will buy their wheels of the parties that will sell them for the least money. There are, of course, some notable exceptions. There are some railroads that will not trade with a firm or a concern that is known to dabble in poor wheels. They only trade with those well known firms whom years of experience have proved make a good wheel, and whose business standing will be a guarantee that they will not make a poor wheel. But I am sorry to say that the number of roads that take that view are largely in the minority, and the consequence is that the chilled car-wheel is deteriorating to an extent that the roads at the present time are obliged to use other wheels solely on account of the danger attending the use of chilled wheels. A good 33-inch chilled wheel can be made for $10. A good 33-inch steel tired wheel will cost five or six times that much. Now the roads are being forced to use wheels costing five or six times as much as a good chilled wheel, simply because the chilled wheel is deteriorating. Something has got to be done to stop the use, and the manufacture if possible, of these poor chilled wheels. Wheels to my knowledge have been offered in the market weighing 550 pounds, 33 inches in diameter, for $6.75. Now, the metal in the pig that ought to go into a car-wheel costs considerably more than that. In fact, I think that it is pretty well understood by car-wheel makers, and by users that have given the matter any attention, that when you buy a wheel for much less than 2 cents a pound you must necessarily get a wheel with some poor material in. Wheels are being sold at not much over a cent a pound, when the pig iron that goes into car-wheels costs from $26 to $30 a ton, which is more than the finished product is being sold for to-day. The wheel-makers and your committee and the committee of the master car-builders have had three sessions, and have gone over this thing and fought it out, and have unanimously agreed upon what you have just heard read, and we believe that it is a fair, honorable, business way of buying and selling wheels. Many of us now buy wheels with a service guarantee. The road that I am connected with gets a mileage guarantee of 60,000 miles. If a wheel makes 55,000 we demand of the manufacturer a new wheel, and we get it. Now, that is simple robbery.

To be sure, we can fall back on the argument that the wheel-makers come forward and voluntarily make these offers, which they do. That relieves us. But in a business point of view it is simply robbery. With this system we get a service guarantee, so that the roads are not going to suffer, and if the wheel does not come up to the guarantee in mileage, or the guarantee in time under freight cars, they make good the number of miles that are lacking, they make it up in money. If the wheel makes more than 60,000 miles, or whatever the guarantee may be, they are credited with the extra amount of miles run, which certainly is fair and reasonable and right between the two parties. But the main point to be considered, and what has led to our effort, is to stimulate the manufacturers to make a better wheel. Under this arrangement the strength of the wheel is determined by the tests proposed. One of these tests is substantially what is known as the Pennsylvania Railroad test, except that I think they reject the hundred wheels in case the test wheel does not stand the test; while this proposes that if the wheel does not stand the test, to try another. If that does not stand the test, then it is optional with the inspector to try a third. If he does not elect to try a third, the wheel must be accepted. If he elects to try a third wheel and that stands, the wheel shall be accepted. If it fails, of course they reject them. That is the Pennsylvania test. The other test proposed has been used quite largely by Mr. Barr, of the Milwaukee & St. Paul road. I am strongly in favor of the latter test. It consists of more blows with a less weight, and striking on the plate instead of on the hub. As I think, the Pennsylvania test simply smashes the wheel without giving us the strength of the wheel. In fact, a wheel-maker, by changing the form of his pattern a little, could easily strengthen up a very poor wheel to stand the Pennsylvania test, while it would be very difficult to do it and make it stand the test proposed by Mr. Barr. However, we thought best, inasmuch as many use the Pennsylvania test, to incorporate that as well as the other, and those parties could select between the two. Now, the test, as we supposed, provides for the safety and the strength of the wheel, and the service guarantee provides for the wearing qualities. Under this system it is for the interest of both parties, and especially the wheel-maker, to make the very best wheel he can, because he knows if he makes a good wheel he will get a good round price for it. It is for the interest of the railroads that he should make the best wheels he can. It is for the interest of the railroads that he should make a wheel that will run eighty, ninety or a hundred thousand miles. I am extremely anxious that this Association should look favorably on this proposal, the object of which is to enable us to get a better wheel and discourage the manufacture of these poor, cheap wheels. I would like to introduce a resolution; I have not got it written, but I will write it if the Chairman requires it:

Resolved, That this Association endorse the action of their committee, and approve of their recommendations.

MR. JOHANN.—I second that motion.

MR. JOHN HICKEY.—I see the committee have recommended the strengthening of the wheel in the centre. I would like to ask what they think is the most efficient test. It seems to me that striking a wheel with a heavy weight on the centre, if it is any test of its wearing qualities is hardly a test of its strength, and I would like to have the convention place itself on record as to which is the proper test. I think by taking these two, it would be a source of confusion, and it seems to me we ought to settle on what would be the most effective test of a wheel while we are at it.

MR. LAUDER.—In reply to Mr. Hickey, I would say that the full committee composed of six members from our two organizations and six wheel-makers discussed that thing thoroughly; and I think we were unanimously of the opinion that the test proposed by Mr. Barr, which is a large number of blows struck on the plate of the wheel, is a surer and better test than what is known as the Pennsylvania railroad test, but we thought that inasmuch as several of our leading roads have adopted the Pennsylvania test, that we would incorporate that in the report, and then let each road select whichever test it saw fit. So far as the wearing qualities of the wheel are concerned, this test proposed has absolutely nothing to do. It is to determine whether that wheel is sufficiently strong to put under a car. If it stands those tests, we assume that it is a strong wheel, that the form of the pattern, the distribution of the metal and the quality of the metal are such that we are warranted in putting that wheel under, because it stood this test. That is what we assume Now beyond that, on this very question, we had quite a fight in the committee. Some of the wheel-makers claim that there should be nothing beyond that; that asking a guarantee beyond that was asking too much. But we took the ground that we must also have a service guarantee to insure a good wearing wheel, because it might be easy to make a pattern arched up so that it would stand these tests, when it was really made of very poor material and would run out in a few thousand miles. So, finally our ideas prevailed, and the wheel-makers unanimously agreed that we should have a service test, and we placed it at the figures you see in the report. The wheel-makers thought we were crowding them. But inasmuch as we are giving in such cases, at least, that guarantee and agreeing to replace every wheel that does not make that with a new one, we thought it was no hardship to require the same guarantee, and require them simply to make up what they do not come up to. That view of the matter prevailed and they agreed to this report. The test is supposed to give us a strong wheel. The guarantee of mileage is supposed to give us a good wearing wheel. I sincerely hope that we shall indorse the method that has been proposed by the wheel makers to get over this difficulty. I think that it is wise to give the two tests. Then parties can choose between them and adopt whichever they see fit.

THE PRESIDENT.—The resolution is that this convention indorse and approve the recommendation of the committee, those in favor will rise on their feet and stand until counted.

Fifty-eight members rose. There was no negative vote.

THE PRESIDENT.—The vote is unanimous and the resolution is adopted.

THE PRESIDENT.—Under the rules of our new constitution the next order of business is the reading of papers and the discussion of questions propounded by members, which is our regular order. Any member present who has a question to propose for discussion will please hand it in.

AIR OPENINGS IN SMOKE-BOXES.

SECRETARY SINCLAIR.—The following question is propounded by W. A. Foster:

"Is it desirable to admit air through passages left in the botton of smoke-box of locomotives ?"

MR. FOSTER.—I have been using altogether a different arrangement in regard to spark-arresters with extension front ends, contrary to all previous ideas, perhaps contrary to common sense. That is to let air into the lower parts of the extension front ends. It is so arranged that we have an adjustable opening and also a permanent opening that cannot be closed. The permanent opening is put is put in the top of the hopper where the slide generally is used, and I use that permanent opening from three inches to three and a half inches in diameter. It makes some difference on the size of the engine. The adjustable openings are twelve in number, and an inch and a half by three inches. I first put these adjustable openings in two inches by an inch and a half, but I found that they were not large enough. My idea was, instead of opening the furnace door and cooling the engine down, to let air enough in through this arrangement to keep the steam down. I found two inches by an inch and a half was not large enough ; in fact a great many times three inches was not large enough. I got a great many consolidations on our road running with these appliances and frequently they run the whole length of the road with them all open. You find by this arrangement that the engines do not haul through near the number of sparks to the front end. In fact we do not calculate to use the front end to carry sparks in. They go down into the hopper through this hole, The engineer can open it any time he sees fit, generally once in every ten or fifteen miles. By tests between this and the old diamond stack, with the same class of engine, I made a saving of something like twenty per cent in the coal consumed. It has always been considered that the front end has got to run absolutely tight. By this arrangement I find I do not know that there is any way of explaining why it is so, but these engines steam quite as freely with that opening and do not haul anything like the amount of cinders through the tube. Of course, it is something that very few persons have had anything to do with. Mr. Ames on the Beech Creek has used this appliance to a certain extent. He uses the opening and leads the cinders thereby out through the opening. I believe he has no valve on the end of the hopper.

THE PRESIDENT.—Is Mr. Ames present?

MR. L. AMES, Beech Creek.—In what I said yesterday I stated my experience. I use the opening at both ends and we have very good success. The engines steam freely and they do not seem to draw much through the flues. We do not seem to have many sparks. It might be well to appoint a committee.

SECRETARY SINCLAIR.—That is rather a startling innovation on the practice of securing draft through the flues of a locomotive, and I fancy if the bottom of the matter was reached, that, according to the law of equivalents, it would be found there were some disadvantages as well as advantages connected with it. There is no doubt but that an opening in the smoke-box, either in the bottom or the top or any other part of it, will soften the effect of the exhaust on the tubes, and consequently will pull fewer sparks through the tubes ; but I think that a better resort would be to open the nozzle, and you would get the maximum results in a better way and have less back pressure in the cylinders. I have an idea that those engines that run with that hole in the bottom of the smoke box could be made to run with much larger nozzles if they were so adjusted that the whole of the exhaust was used to draw the gases through the flues. I think that is a matter which is worthy of consideration and investigation, before any one assumes or concludes that this is an improvement on draft appliances. I decidedly do not want to raise my voice against any method of improvement; but I am afraid that the utility of that improvement is somewhat doubtful.

MR. FOSTER —I would say we are using the same sized nozzle we did before. We must have a nozzle small enough to work the fire when the engine is working light. We burn on our road fine coal, such as we have no sale for, soft coal screenings, and we need rather more draft, probably, than we would with coarse coal. I understand that there are some engines working on another road that are using just the same exhaust nozzles in both cases, and they are running a permanent opening of five inches, if I understand it right, and they have a variable opening of six inches.

MR. MACKENZIE.—I heard of those openings some time ago, and being anxious to try all the devices in the way of extension fronts, I took hold of one. My experience with that device was that the engine would not steam under any condition. We commenced with a four-inch hole and reduced it down to an inch and a half and we made out to get over the road two or three trips with it ; but I arranged a wedge in there with a hole in it so that I could close the hole up to any position I wanted or shut it clean off if I desired, and we always found when the traveling engineer would get on the engine they would open it, and as soon as he got off it would be shut. The road department got on to the scheme and they very soon stopped it, because sparks were dropped on the track.

MR. FOSTER.—Most of the freight we carry is coal, and we have consolidation and mogul engines running there that are making from 18 to 20 miles an hour right along. In fact, last week, with a mogul, we made a trip from Corning to Newbury, which is 112 miles, down and back, with a tank full of coal, and she had something like two tons of coal left in the tank after making this trip. She hauled 28 loaded cars down and 32 back. She made 20 miles an hour going down and about 18 miles an hour coming back, and it took some steam to do this business and we have got as good steaming engines, I think, as most anybody.

MR. MACKENZIE—I do not wish to have the member understand that I want to cry down his device. If it is a good thing, I would like to have it on our road; but the question occurs to me now, if he has not got some specially large fire boxes in which he uses this appliance, 8 or 9 feet long, perhaps 12 feet long? I tried this on a 72-inch box. With our 72-inch box we can fill that arch up in a 45-mile run. We could not take care of those cinders in that 3-inch hole; they would not run out; they would simply clog up and burn, and the jarring of the engine would disturb some of them, to be sure, but they would not come out fast enough. Just the moment that they got covered up thoroughly the engine would steam somewhat better. Still, the arch was red hot all the time.

MR. FOSTER.—I would say that most of those engines have very large fire boxes. The moguls are 9 feet in length and 42 inches wide. The consolidations are 10 feet. It works better on a large fire box than it does on a small. But if the engine is handled properly, there is no trouble with a small fire box. That is, I have had no trouble. I have got engines with a 72-inch fire box that give very good satisfaction in every respect.

MR. JACOB JOHANN.—The point in question is novel to me. In all my time I have always found that if I wanted good results from engines, that is, in the way of steaming, it was necessary to have the front end perfectly tight. Whenever it was reported that the engine did not steam well, I generally looked among the first things, to see whether everything was tight in front. I can hardly see where the advantage of that opening comes in. I would suggest to the gentleman as he is using them in that way, that he take two engines of similar capacity, precisely alike, and take one and close it up tightly in front and run the other as he is running it, and then come here and give us some cold facts, such as Brother Stevens likes to have all the time. I think that will tell the tale better than any discussion we can have on the subject I can hardly see the philosophy of opening the front end. I know some years ago, we had a couple of those Reading engines on the road with which I was connected at that time, and they had a diaphragm at the front end and they were engines that steamed very freely; and when we did not want any steam we opened that diaphragm in front and then it cooled down, and I think the tendency of having any opening in front is to partially destroy the draft. If he can run his engines with an opening in front, it is my opinion that he will run them to much better advantage if he could close the opening and open the nozzle, as Mr. Sinclair says. But I would like very much if he would go to the trouble of making a thorough test of the matter between two engines of the same capacity.

MR. MACKENZIE.—I would like to ask Mr. Foster one question, Mr. President. At what point of the extended arch does he set the hopper, whether at the centre, or back near the saddle, or forward; also the length of the extension.

Mr. Foster.—I would say that the extension is eighteen inches long. I put just as little extension as I can.

Mr. Mackenzie.—I move that the discussion be closed.

The motion was carried.

FEED WATER HEATERS.

Secretary Sinclair.—The following question is proposed by Mr. A. G. Eastman:

"Is it desirable to use any device to heat the feed water for locomotives either from the exhaust steam or otherwise?"

Mr. Eastman. — It occurred to me as I was sitting here at this time that I would like to hear something from some people who have been using feed water heaters. Just at the time that I left the railway with which I have been connected, I was induced to attach a feed water heater to an engine that the company had bought before I went there, and which was over-cylindered ; her boiler had not the capacity for the cylinders. I have heard from the engine only occasionally, and it occurred to me as I was sitting here, that one of the officials of the road remarked to me only a few days ago that the engine was doing remarkably well, far better than ever before. I do not know whether there is any one present who is using a feed water heater or not. I know they are in use by the Connecticut River and Passumsic, and I also observe that the South Eastern has put one on to one of their big engines. How they come to be induced to put it on I don't know. Of course I suppose it will be admitted by all that it is desirable, if there is any means by which it is practicable, to utilize the waste heat. I simply brought the question up to hear the remarks of other members, if they have any experience.

The President. — Is there any gentleman present who has any experience in the use of feed water heaters on locomotives ? Mr. Paxson has not done any talking this session, and he has had a good deal of experience in almost everything.

Mr. L. B. Paxson. — Carefully tested experiments were made on the Reading railway upon this subject, weighing coal and measuring water, and there was no advantage found in those devices, and they were, as you know, thrown off.

On motion the discussion was closed.

SAFETY STEPS ON PILOTS.

Secretary Sinclair. — In the course of one of the reports submitted to the Master Car Builders' Association, recommendations were made that steps be used in front of locomotive pilots, and they also recommended that it should be drawn to the attention of the Master Mechanics' Association, and if I am perfectly in order I think it would be desirable to have the views of the members at this time, on whether they consider it desirable to place a step on the front of the pilot at each side, so that the brakeman can put his foot on while coupling. It is desirable for the Association to go on record either for or against it, and as the recommendation has been made by certain railroad commissioners, I think it should be taken up without delay.

THE PRESIDENT.—As Mr. Sinclair says, this is an important matter, and it would be well for the Association to give an expression of their views on the subject. In building locomotives we sometimes have specifications requiring steps, but it is not usual to put them on unless specified ; but the cost is a mere nothing, and as it is an element of safety and has been so decided by the Commissioners of certain States, I think it would be well to put ourselves on record.

MR. ALLEN COOKE, Chicago and Eastern Illinois.—I put on the step where the slats are perpendicular or slant-wise, up and down on the pilot. Where they are the other way and spread apart some, on freight engines, I do not put them on. There is a chance there for the brakeman to put his foot in on the lower frame of the pilot.

SECRETARY SINCLAIR proposed the following resolution :

Resolved, that it is the sense of the Master Mechanics' Association that the pilots of all engines should have steps placed on the front end for the safety and convenience of brakemen while coupling at the front ends.

The resolution was seconded by Johann and unamiously adopted.

NEW ASSOCIATE MEMBER.

THE PRESIDENT.—We have a report on associate membership that should be forthcoming.

Secretary Sinclair read the following :

The Committee appointed on the application of Mr. D. L. Barnes for associate membership, respectfully recommend that Mr. Barnes be admitted.

JACOB JOHANN,
J. DAVIS BARNETT, } Committee.
H. A. WHITNEY,

MR. STEVENS.—I move that the report be accepted and the candidate balloted for.

The motion was carried.

THE PRESIDENT.—I will appoint as tellers Mr. John Mackenzie and George W. Stevens. Those in favor of the admission of the candidate will put on their tickets yes and those opposed no. Five noes reject the candidate.

The balloting was then proceeded with and the result was announced by the Secretary as follows: Yes, 32; No, none.

THE PRESIDENT.—Mr. Barnes is duly elected an associate member of this Association. The secretary will read the report of the auditing committee.

The report of the auditing committee was read by the Secretary and is as follows:

REPORT OF AUDITING COMMITTEE.

GENTLEMEN: Your committee have duly audited the accounts and vouchers of both the Treasurer and Secretary and find them correct, and have also examined the United States four per cent bonds of the Boston fund to the amount of $6,200.

J. DAVIS BARNETT,
JOHN PLAYER,
CHARLES BLACKWELL.

MR. MACKENZIE—I move that the report of the auditing committee be received.

The motion was carried.

QUESTION ON ORDER OF BUSINESS.

MR. HICKEY.—I would like to inquire if the hour for the introduction of new subjects has passed.

THE PRESIDENT.—Under the new constitution, sir, that has passed.

MR. HICKEY.—There was a subject I was anxious to introduce and one which I think is of great interest to the Association.

THE PRESIDENT.—There seems to be a little conflict in the recent constitution. The 13th order of business is the reading of papers and discussion of questions proposed by members. Then there is a sixth order of business which says: "Unless otherwise ordered the discussion of questions proposed by members shall be the special order from 12 o'clock to 1 p. m. of each day of the annual meeting." I think Mr. Barnett will have to explain that a little.

MR. BARNETT.—I made the note in reading that, that one of the clauses which was not clear referred to the discussion of mechanical matters in the noon hour.

MR. MACKENZIE.—I do not understand that that hour has been privileged to us yet. We have simply had a recess of five minutes.

THE PRESIDENT.—In the order of business there are two rules applying to this matter. Under the explanation of the chairman that is the way it was intended to be, "Unless otherwise ordered the discussion of questions proposed by members shall be the special order from 12 o'clock to 1 p. m." That business as well as the 13th, it seems to me ought to come under the same head "Reading of papers and discussion of papers proposed by members." That is 13th. That is now the order of business.

WATER SPACE ROUND FIRE-BOX.

MR. HICKEY.—The question which I proposed was this: "Is the water space surrounding the fire-box of a locomotive, as at present constructed, sufficient to permit a rapid formation of steam and at the same time admit of a free and unimpeded circulation of water?"

I have often thought that we were not transmitting the full amount of heat from the coal to the water, for the reason that we were not getting at all times a good circulation of water in contact with the fire-box sheet. It will be admitted that if the heating surface of the fire-box is more efficient than that of the flues, it is very necessary, at that point at least, that we should have a very good circulation. The well known practice of the present water space, the smallness of the space, does not, it seems to me, permit of free currents, which to my mind are absolutely necessary for the taking up of the full amount of heat in the fire-box. It is necessary, certainly, that the outward currents have free and unimpeded passage as also the downward current of the water. If that is to be free and effective, we must have, it seems to me, a wider space than we are now having. The spaces at present, I believe, are from three to four and a half inches, more or less, and I am struck with the impression that we had better increase the water space surrounding the fire-box.

Mr. Peck.—It seems to me if we enlarge our water space we consequently lessen our fire space, and if the water space is at any time dry, I should think the stay-bolts would show a leak, and if they show a leak we certainly have not got enough. If they are perfectly tight, we have.

Mr. William Swanston.—I think that this is a very important question. From some little experience that I have had and some few experiments that I have made, I think that the water space ought to be increased gradually from the mud-ring to the top of the fire box. I think that is desirable for the purpose of increasing the circulation, and also for the purpose of giving a greater length of stay-bolt. It is well known that the difference of expansion between the outer and inner shell is the cause of the breakage of the stay-bolts, and by an increase of their length that difference is reduced. I think that these are two important points that are gained by the increase of the width of the water space at the top. I do not see any use of increasing the space at the bottom.

Mr. Stevens.—I move that the discussion be closed.

The motion was carried.

The President.—I am requested by the chairman of the nominating committee to state that the members will meet in the ante-room at once. Their names are J. N. Lauder, J. Davis Barnett, George Hackney, J. F. Devine and J. M. Boon.

NEXT PLACE OF MEETING.

The report of the committee on the place of holding the next meeting is in the hands of the Secretary and will be read.

Secretary Sinclair read the report of the committee, which recommended Chautauqua Lake, Montreal and Saratoga.

Secretary Sinclair.—I propose Pittsburgh.

The motion to add Pittsburgh was lost.

Mr. Stevens.—I would add Niagara Falls.

The motion to add Niagara Falls was carried.

The President.—The members will prepare their ballots for voting on the place of meeting. One of the three highest is to be selected by the Executive Committee. Mr. Mackenzie and Mr. Stevens will please act as tellers. I think it would be a good idea for the members, in voting, to vote for three on each ballot, inasmuch as there are three places to be selected, taking any three of the four names.

MR. EASTMAN.—Would it not be well for those voting in that way to put their first choice at the top? It might enable the committee to form an idea of the first choice of most of the members.

THE PRESIDENT.—They can put that on the ballot; there is no objection to it.

MR. MACKENZIE.—There certainly is, Mr. President. The constitution positively says that the matter is settled by the Executive Committee.

THE PRESIDENT.—I think Mr. Mackenzie is right about that.

MR. SWANSTON.—I would like to ask a question. I understand quite a number are in favor of Chautauqua lake, but the month of June is commencement season with colleges there. Is it not likely that the hotels will be so crowded that they can not accommodate us?

MR. MACKENZIE.—I will say, first, that that matter will be thoroughly canvassed by the Executive Committee no doubt, before the place is settled on; but I am assured by people who live at Dunkirk and Erie, and that neighborhood, that there is ample accommodation for our people, that the hotels are large, the climate is good, the water is good and there is plenty of it. Fishing is good, and the hotels will accommodate us for a very small sum; I understand one of the members to say it will not exceed $2.50 a day.

MR. SPRAGUE.—I would say that I do not think there is but one place on Chautauqua Lake that could accommodate us, and that is at Lake Wood, two miles above Jamestown.

MR. SWANSTON.—I have received some information since that there is ample accommodation there.

SECRETARY SINCLAIR.—I should request gentlemen to remember the kind of accommodation they got at Niagara Falls the last time they were there. There are very seldom so many complaints as there were at Niagara Falls, and it would be well not to give an opportunity for repeating them.

Secretary Sinclair announced the result of the ballot to be as follows: Niagara Falls, 29; Chatauqua Lake, 26; Montreal, 26; Saratoga, 20.

THE PRESIDENT.—Chatauqua Lake, Montreal and Niagara Falls, having received the highest number of votes, will be the three places from which our next place of meeting will be selected. The next business in order will be the report of the nominating committee, if there is nothing else.

COMMITTEE ON RESOLUTIONS.

THE PRESIDENT.—There is to be a committee appointed on resolutions, if some gentleman will make a motion.

MR. STEVENS.—I would move that the Chair appoint the committee on resolutions.

The motion was carried.

THE PRESIDENT.—The Chair will appoint on that committee Mr. Gentry, Mr. Cook and Mr. Foster. The gentlemen will please get together and make up a report as soon as possible.

ASSOCIATE MEMBERSHIP.

THE PRESIDENT.—We have a communication here applying for membership. Under our new constitution, however, it is informal, as it requires the signature of two members. If Mr. Gentry is present and will get the additional signature, it can be acted on. Mr. Gentry not being in the house, it will be laid over. The Secretary will read the clause of the new constitution touching applications such as we have before us.

Secretary Sinclair read the clause in the new constitution touching applications for associate membership.

MR. LAUDER.—I would like to explain the action of the committee on the constitution in regard to that clause. It is changed somewhat from the old method and for this reason—we introduced the word "special," that is mainly the change that we made—any one that would be of *special* advantage to have in this Association we would like, perhaps, to have become an associate member. Now civil and mechanical engineers and others who are not eligible for active membership join this Association, for what? Personal gain of course; and that is business; that is right, too. They come here because of some supposed advantage it would be to them. That is what I should join it for. Now it is for the Association to say whether they can be of advantage or not to us to off-set it; that is the point. Several years ago we inaugurated a system here—I think it has been allowed to lapse—of requiring two of our associate members each year to prepare and read at our Annual Convention, some paper on a scientific subject which they might select themselves. That was to get something back from the associate members in return for what we give them, as I assume we do give them something, or they would not stay with us. I do not think there is an associate member of this Association present at this meeting. Now what good are they to us as an organization? We introduced that word "special" so that hereafter we will, perhaps, bar out some men that are of no particular advantage to us, that have no special attainments that would be valuable to this Association. Every mechanical and civil engineer has qualifications, perhaps, that would be a benefit to us; but we want some one that has special qualifications in the future, and we want to be very guarded how we admit men as associate members. They generally have a purpose, and as I said before, that is right. They join because of some supposed advantage it would be to them, and that is right; nobody finds any fault with that. But let us see that we get members that are going to be of some benefit to us, to offset that. That is why that clause was made a little more rigid than it was before; and I hope the members will bear in mind that because a man is a good fellow, we are not obliged to admit him into the Association, as the associate members of this Association have been, for twenty years, of very little use to us.

Would it be in order at this time for me to propose a name for honorary membership.

THE PRESIDENT.—Yes, sir.

ELECTION OF HONORARY MEMBER.

MR. LAUDER.—Then I move that the name of George A. Coolidge, who is now an active member and has been since the organization of this Association, be placed upon the list of honorary members.

The motion was carried unanimously.

REPORT OF NOMINATING COMMITTEE.

THE PRESIDENT. — The report of the nominating committee will be read.

SECRETARY SINCLAIR read the report of the nominating committee as follows :—

" Gentlemen : Your committee on nomination for officers would report the following, namely : J. H. Setchel, for president ; John Mackenzie, first vice-president ; George W. Stevens, second vice-president ; G. Richards, treasurer ; Angus Sinclair, secretary.

J. N. LAUDER,
J. DAVIS BARNETT,
JOHN L. DEVINE,
JAMES BOON.

MR. LAUDER. — I desire to say that the reason why Mr. Hackney's name is not signed on that report is because he was not present, and it was necessary for the committee to act at once. I have no means of knowing whether he would sign the report or not.

I would say right here that I do not believe in this way of doing business. I do not believe in nominating committees. It looks as if it was cut and dried. It is apt to make enemies to the committee. I believe it is all wrong. I think that under the constitution our members have a right to place in nomination any member they choose.

MR. STEVENS. — I feel very much obliged to the nominating committee for placing my name on the list, but I must respectfully withdraw. There is a time when men are sometimes justified in renouncing their friends. I am quite sure that I could not attend to the duties, and I beg leave to have my name withdrawn and some one else's substituted.

MR. LAUDER. — I think that we had better elect Mr. Stevens vice president of this Association. His talk about not being able to attend to it is all nonsense. There are no duties, only to sit up there and be gazed at, and as handsome a man as he is would certainly grace that position. I think that Mr. Stevens had better be elected vice-president of this Association. I do not believe he has any right to withdraw.

MR. STEVENS. — I think that I have a right to and I shall insist on it. Since Brother Lauder has put it in the light of an ornament, I think I am more justified in withdrawing. Now I decline at all times to seek notoriety or be ornamental, and while he has complimented me on my good looks and what a handsome ornament I would make, I cannot accept it; it will not inveigle me any. I respectfully withdraw.

THE PRESIDENT. — Mr. Stevens will be excused. The question will be on the reception of the report of the committee.

The report of the committee was accepted.

ELECTION OF OFFICERS.

THE PRESIDENT.—The members will prepare their ballots for the office of President. I will appoint as tellers Mr. R. W. Bushnell and Mr. W. F. Turreff.

A vote was taken, the result of which was announced by the Secretary as follows: Setchel 45; Briggs 3.

MR. BRIGGS.—Gentlemen, according to the ballot, Mr. Setchel is elected President for the ensuing year. (Applause.)

PRESIDENT SETCHEL.—Gentlemen, I am very much obliged to you for this compliment, but I feel too fatigued and unwell to make any protracted remarks at this time. If you will excuse me, I will agree to make you a good speech another time.

MR. HICKEY.—I move to make that vote unanimous.

The motion was carried.

THE PRESIDENT.—The next order of business is the election of the First Vice President. Gentlemen will prepare their ballots for the First Vice-President.

The balloting for the First Vice-President was proceeded with and resulted as follows: Mackenzie, 18; Briggs, 15; Stevens, 8; scattering, 4.

THE PRESIDENT.—No one having received a majority of all the votes cast, there is no election. You will therefore prepare your ballots again for the office of First Vice-President.

The result of the second ballot was as follows: Briggs, 24; Mackenzie, 22.

THE PRESIDENT.—Mr. Briggs is declared duly elected First Vice-President of the Association.

MR. SPRAGUE.—I move that the election of Mr. Briggs be made unanimous.

The motion was carried.

MR. BRIGGS.—Gentlemen, allow me to thank you. I did not consider myself in the field at all. The manner in which the committee seemed to try to freeze me out, I did not think was just, and on that account I said nothing when my name was put in the ballot. I am happy to be your Vice-President again and I will try to fill the place as well as in me lies.

Mr. Lauder.—Will you allow me to say a word? You will all see the embarrassment that this making of nominations by a committee has placed upon the Association and has placed upon our friend Briggs, and has placed upon Mr. Mackenzie, and has placed especially upon the committee that had those nominations to make. I want to give notice here and now, Mr. President, that I shall propose an amendment of the constitution, to be acted upon at the next meeting, that the officers of this association should be elected by ballot without nomination. That is democratic; it is right, and it does not place any one in a false position, and makes no enemies, no bickering and no feeling that somebody has been trying to injure somebody else. I give notice and I will propose an amendment to that effect.

Mr. Stevens.—One feature of Mr. Lauder's motion I do not understand. He says "without nomination." It seems to me right that the officers should be nominated in open convention, and then that we should proceed to ballot in the manner that he has described. I hope he will embody that change in his amendment.

The President.—This matter can be discussed after we get through with the election of officers. Gentlemen, prepare your ballots for the election of the Second Vice-President.

The ballot for Second Vice-President resulted as follows: Mackenzie, 35; Stevens, 8; scattering, 4.

The President.—Mr. Mackenzie having received a majority of all the votes cast, is declared duly elected as Second Vice-President of the Association for the ensuing year.

On motion the vote was made unanimous.

Mr. Mackenzie.—Gentlemen, I thank you. I was going to say that I do not see how I can be a candidate under the constitution. Mr. Stevens was the nominee of the committee and there were no other men named and I think the ballot was unconstitutional.

Mr. Lauder.—Another illustration of the evils of a nominating committee.

Mr. Mackenzie.—Yes, I think it is all wrong. I take this occasion, gentlemen, of thanking you again for the compliment.

The President.—Gentlemen will prepare their ballots for the election of a Treasurer.

Mr. Lauder.—I move that the Secretary be authorized to cast the ballot of the Association for George Richards for Treasurer.

The motion was carried unanimously, and the Secretary cast the ballot for Mr. Richards.

The President.—The next business in order will be the election of a Secretary. Gentlemen, prepare your ballots for the election of a Secretary.

Mr. Johann.—I would move that the First Vice-President, Mr. Briggs, be authorized to cast the vote for Angus Sinclair as Secretary of this Association.

The motion was carried, and Mr. Briggs cast the ballot of the Association for Mr. Sinclair.

THE PRESIDENT.—Mr. Sinclair, I have the pleasure of informing you that you have been unanimously elected Secretary of this Association for the ensuing year. [Applause.]

SECRETARY SINCLAIR.—Gentlemen, I thank you for that evidence of your confidence in a new incumbent of the office. If you will all answer the replies to the circulars, and send in the reports in good time so that I can get them in proper shape for the Convention, you will make me the happiest officer that you have. [Applause.]

VOTE OF THANKS TO SECRETARY SINCLAIR.

MR. HICKEY.—I move that the thanks of this Association are due to Mr. Angus Sinclair for the able and efficient manner in which he has performed the duties of Secretary for the past year.

The motion was seconded by Mr. Turreff and others, and carried.

MR. JOHANN.—I think that not only are our thanks due to Mr. Sinclair, but I think it is due that this Association should name a salary for him for the ensuing year. That would be more satisfactory than the thanks, probably.

THE PRESIDENT.—That should be attended to.

MR. STEVENS.—I would move that the salary of the Secretary be made $1,200 a year.

The motion was carried.

The Secretary read the report of the Committee on Resolutions, as follows:

REPORT ON RESOLUTIONS.

Your committee respectfully offers the following:

Resolved, That the thanks of this Association are due, and are hereby tendered, to the Rev. C. T. Evans and the Rev. E. T. Kenyon for their services in opening our proceedings; to the ladies of Alexandria Bay for plants, flowers, etc., etc., to adorn the stage; to Messrs. Royal and Minor and their ladies for decorating the hall; to the committee of Entertainment for their kindness in providing for us and our ladies delightful trips on the river and other enjoyable occasions; and to the press for reporting and noticing our proceedings.

T. W. GENTRY,
ALLEN COOKE, } Committee.
W. A. FOSTER,

MR. SWANSTON.—I move that the report be adopted.

The motion was carried.

MR. JOHANN.—There is one other matter that I wish to bring to the notice of the members. I understand that some of our annual reports are very nearly out of print, so much so that younger members coming in cannot procure any, nor can we furnish any to scientific institutions that are constantly asking for them. I am very glad to know that our reports have got so valuable now that scientific institutions ask for them, and I therefore would move that the Executive Committee be instructed, in addition to printing the report of this meeting, to also provide a sufficient number, in their judgment, of previous reports that are practically out of print at the present time.

The motion was carried.

The following paper was accepted, but for want of time was not read.

BOILER STEEL.

In the manufacture of boiler material the first requisite is a mass of metal of perfectly homogeneous or uniform character, capable of being rolled. This mass must be large enough and of proper shape to be rolled handily into large sheets. Wrought iron is not a good material for this purpose, largely because it can not be obtained in a homogeneous mass of sufficient size. The difference between wrought iron boiler plate and what is known as steel boiler plate is that the blooms which are necessarily welded together in making wrought iron boiler plate are melted into one mass in making steel plate. That is, commencing at the start in either steel or wrought iron plate, the ores are first smelted in the blast furnace, the product of which is cast iron, as seen in the "pig." These pigs are then melted in a puddling furnace, the product of which is the puddled-ball or a spongy mass of isolated particles of iron weakly bound into one mass by the melted cinder, slag, etc.

To bring the particles of iron into contact, so they may unite and form one mass of iron, it is necessary to separate the cinder, etc., from them, which is accomplished by the mechanical action of steam hammers, rolls, squeezers, etc. The mass is then rolled into muck bar, which is cut up cold by shears, piled, heated and welded together again, the latter process being repeated as the purer result is desired. The result is the wrought iron bloom. In making wrought iron plate a large number of these blooms, owing to their small size, are heated and welded together in order to obtain a mass large enough—1,800 to 3,000 lbs., according to the size of sheet required—to roll into a single sheet. As the ingot from which wrought iron boiler plate is rolled is made up from the numerous smaller blooms bound together by welding, it follows that as welding at best is but a partial process of cementation owing to the cider and slag which can not be entirely freed from the iron, and which are found in streaks all through the ingot, preventing homogeneity in the slightest acceptance of the term, that the resulting sheet is made up of streaks of iron separated by spots and streaks of cinder, resembling, to a certain extent, several thin sheets of brass held together by the process of "sweating," soft solder between them, which, if put into service as a side sheet in a locomotive fire box would result in the melting of the solder and of the swelling or bagging out of the sheets closest to the fire, which in wrought iron plate is known as "blistering." That is, the cinder, etc., in wrought iron boiler plate is similar to the soft solder in the supposed case of brass sheets. The following from Alexander L. Holly's work on the "American locomotive" and who was afterward the father of the Bessemer process in America, is to the point: "There appear to be four principal defects in our fire-plates, blistering and cracking, resulting from a comparative want of homogeneity; corrosion, and comparatively small conducting power. The comparative want of homogeneity in iron is both an indirect and a direct cause of its ultimate failure. It facilitates the formation of blisters in the manufacture of the plate, and it offers less resistance than copper to the trying effects of fire.

The difference of temperature to which its respective sides are exposed, causes unequal expansion and contraction in even a one quarter inch plate. This, by constant repetition, sensibly affects the cohesion of the particles of any compound substance. Were iron more nearly pure and the disturbance of temperature act on simple molecules of metal, without the interposition of cinder, the deterioration would, of course, be less rapid. The failure of all very "raw" iron under alternate compressive and tensile strains, illustrates this fact. Blistering is due chiefly to the imperfect welding of the component parts of the pile of blooms composing the plate, the imperfect weld being incident to the oxidation of the surface while heated. Many of the cheaper kinds of plate are made of a pile of three blooms; the outside strata are sound and reheated; the inside strata are "raw," poor iron. Such plates are, of course, very liable to blister. The experience with the cheaper boiler irons is that very large plates are soundest at the edges, and especially weak and liable to blister in the center.

This is attributed to the inadequate heating of the central part of the pile, causing an imperfect weld. But when the pile is considerably flattened under the hammer and then heated, its center is, of course, thoroughly softened, and the difficulty mentioned is not experienced so often. Indeed, such plates are found soundest and strongest in the middle, the edges being more strained by the process of rolling, and probably contain some cinder which has been worked from the inside of the pile. Large plates may be made from single blooms, if the central part of the bloom is so softened by reheating and gradual flattening as not to modify the texture and soundness of any part of the iron. Plates thus made, and avoiding the difficulty mentioned, are vastly superior in other particulars, etc." Good wrought iron boiler plate is unquestionably superior to poor steel plate; but, notwithstanding all possible care in the manufacture of iron plate, the failures from "blisters" occur much too frequently to make it a safe material, even when it is the best, to use in boiler fire surface, and for this reason it has entirely gone out of use in locomotive fire-boxes.

The crucible process of making steel is the oldest, commercially speaking, and for some purposes the best—that is, when steel is wanted in small quantities of considerable purity. It is a failure when large masses of homogeneous character are required, as is the case in boiler plate. Its shortcomings in this respect are due to the process of manufacture, which, as is well known, consists in melting wrought iron, etc., in a crucible holding generally from 80 to 125 lbs. To obtain a mass large enough to make boiler plate, it is necessary to pour the contents of from twenty to fifty crucibles into one mold to form an ingot. As the "steel" is made in each crucible, it follows that in thirty crucibles we have thirty different kinds and grades of steel in the one sheet. The result, when subjected to the trying conditions found in a locomotive fire-box, is of course disastrous in the majority of cases, as homogeneity or absolute uniformity of the metal in this service is one of the most important elements found in long lived fire-boxes.

In the ordinary open hearth process from six to twenty tons of steel are made at a heat. The process consists of a melted cast iron bath in a Siemens-Martin furnace. Into this bath the wrought iron blooms (which in wrought iron boiler plate would be piled and welded together, as already described) are placed and melted together, with certain small quantities of forro-manganese, spiegeleisen, etc., which when thoroughly mixed is tapped off and run into ingots of from 1,500 to 4,000 lbs. each. This process of obtaining the ingot by melting or fusing the wrought iron blooms, and then casting them into a single mass large enough for a plate, is evidently far superior to the old process in wrought iron plate of welding them. If crucible steel could be obtained by manufacturing it in one large crucible in place of many small ones, the steel in each crucible of which is of a different individuality, so to speak, the result would be better than the open hearth process, as the crucible process starts with the purest of refined iron, while the ordinary open hearth process requires a bath of necessarily crude and unrefined iron (cast iron), or from 20 to 50 per cent. of its product. Thus, while the crucible process gives poor results in boiler plate, owing to a want of homogeneousness, the ordinary open hearth process is short in its requiring a bath of cast or crude iron forming a large proportion of its product, which is vitiated to the extent of the cast iron bath. Certain steel works in Pittsburgh, have in operation a process which does not require a cast iron bath, but allows of making large quantities at a heat, thus combining the purity of the crucible process with the uniformity of the open hearth. The influence of the cast iron bath on the product is of course in proportion to its fractional part of the product. The kind of cast iron is of course largely influential on the result. Irons specially free from phosphorus are sought for this purpose. As wrought iron may be purified to any extent, the purity of the open hearth furnace product is necessarily due very largely, if not entirely, to the bath. Open hearth boiler steel, it will be seen, is simply an addition to the process of making wrought iron boiler plate, as it is identically the same up to the point where the metal assumes the form of blooms, and as before stated, the iron boiler plate is rolled from an ingot melted or fused into one mass. The distinction between wrought iron and steel in several European countries is that a compound of iron which when heated and cooled in water does not harden is iron, while one that does harden is steel, but in the American acceptance such compounds of iron as have been cast from a fluid state into a malleable mass are steel, and it is evident from the foregoing that this is the chief difference between wrought iron and open hearth steel, as no boiler steel which when heated and cooled in water and becomes harder is fit for boiler purposes. In fact, this treatment should anneal the steel or soften it, if the material is fit for boiler use. It is a safe practice to reject every sheet which hardens by working or flanging, or by cooling in water, as absolutely unsafe for fire surfaces. The constituents of boiler steel are carbon, phosphorus, manganese, silicon and sulphur, and, of course, metallic iron. The best compound of iron for any purpose is one which approaches nearest to containing nothing save pure iron and carbon.

For boiler purposes the carbon may vary from .10 to .20 for different tensile strength, and increasing the carbon as the harder and stronger material is required, to 1.00 and 1.25 or upward. The effect of phosphorus is more influential than any other constituent save carbon, and the value of steel is in proportion as phosphorus is absent. Its effect is to harden steel, crystallize it, decreasing ductility and promoting brittleness and tendency to crack, and it is the greatest enemy boiler steel has to contend with. From .035 upward steel should not be used for fire-box purposes, though much steel is used with the phosphorus up to .070, and it is hardly necessary to say that it is such sheets that crack. Phosphorus is the great bane of boiler steel. The effect of silicon in a very reduced degree is similar to phosphorus, but when it is reduced to .015 to .020 its effect is nil. Manganese is beneficial in practice up to .30 or .35. It promotes malleability, toughness and strength. Sulphur is an enemy to steel, and is never found in good fire-box steel.

All of these elements save phosphorus are comparatively easily controlled, and other things being equal, the value of fire-box steel is dependent on the absence of phosphorus. The writer has seen the analyses of some 450 locomotive fire boxes, which had been in service and failed in from two weeks up to 12 years. The constituents were practically the same in all of them save phosphorus, which was up to .070 in the short lived ones, and as low as .020 in the long lived ones. The average fire box steel sold averages .035 in phosphorus, but the steel made by the new processes runs as low as .010 in phosphorus. Tool steel makers (crucible)purchase the scrap steel cut off in squaring up sheets, and value it according to its freedom from phosphorus. For instance, .020 phosphorus is worth $55.00 per ton, while .030 to .040 is worth but $25.00 per ton. The purest steel (crucible) in the world is that used by watch makers and engravers in their tools, and it has but .008 in phosphorus. The best tool steel found in America has .012 of phosphorus, and is unfit for fine watch makers tools, etc.

Ordinary tool steel has .018, while common tool steel runs to .025, and above .025 in phosphorus steel is useless for tool steel purposes. The conductivity of different metals for heating, taking silver at 100, as follows :

Silver	100
Copper (rolled)	74
Steel with not over .010 of phosphorus	60
Steel up to .025 in phosphorus	51
Ordinary fire box steel up to .035	42
Good wrought iron	40

Purity of steel has very much to do with economy of fuel. For instance, the writer has seen steel boilers on a tow boat which analyzed .040 in phosphorus, replaced with new ones exactly similar in every respect, except in purity of the steel — it had .011 in phosphorus. The boat with the new boilers did better for a test of six months by 17 per cent. Another case was that of a steam fire engine which had a boiler replaced with a new one. The old boiler had .050 in phosphorus, while the new one had .013 When new the old boiler had never generated steam at 5 lbs. pressure in less than 6 minutes. The new boiler, which was identically the same as to size, etc., generated 5 lbs. pressure in 3½ minutes.

Pure copper is the ideal metal for fire boxes, on account of its conductivity of heat and extreme ductility, which allows of its stretching to accommodate a strain, in place of cracking as poor steel does. A compound of iron which most closely resembles copper is then the best metal for fire boxes, and to get such a material depends chiefly on its freedom from phosphorus.

FRANK C. SMITH,
Master Mechanic, Peoria, Decatur & Evansville Railroad.

THE PRESIDENT. — Is there any further business to come before this Association.

DEFENCE OF ASSOCIATE MEMBERS.

MR. WHITNEY. — I wish to draw the attention of the association to a few remarks Mr. Lauder made a short time ago. I think they were a little hasty and unfortunate and ill-advised. He questioned the use of associate members to this institution. He wanted to know if any of them have rendered us service. I think there are some associate members whose names Mr. Lauder could run over in his mind as having rendered very efficient service to the Association — notably Mr. Forney, and I think there are several other members of this society that have read valuable papers before the Association. I think his remarks were rather too sweeping, and I think on second consideration he will think so himself.

MR. LAUDER. — Mr. President, I do not know but what the gentleman is right. I am apt, perhaps, to speak my mind pretty freely, and perhaps sometimes say what on consideration, as he suggests, might seem to be a little sweeping. We have, of course, some valuable associate members, and members that have in the past rendered us some very valuable service, but they could render us a greater service if they would come here to our meetings, and participate in our discussions, and assist us in doing our business. It is a very rare thing to have an associate member meet with us at our annual convention. It is only when they are appointed to do certain things that they do anything; and in some cases they have neglected even to do that when they were regularly appointed to prepare papers. I think, as a class, they are of no particular advantage, as I said before; but there are some amongst the associate members who have rendered us valuable service, for which the thanks of the Association are due. But I hope that this association will not allow the custom that we inaugurated several years ago of requiring some papers to be presented by two of our associate members each year, to lapse, because they give character to our report, What we need, of course you all understand, in our Association matters, is more technical and scientific knowledge. We are all intensely practical. We can some of us talk very well and express our ideas so that people can get the drift of what we mean, but there are comparatively few of us who can sit down and write a treatise that would be proper to incorporate in our Annual Report that reaches the whole world. My idea was that the very idea of having associate membership, was to enable us to have talent in the Association, and I hope our President will see that at the next meeting some of our Associate members are called upon to furnish the necessary papers.

MR. WHITNEY —I just wanted to call attention to this thing, because if it went out without any explanation, it might go out as the voice of the Association.

Mr. Johann.—I have felt a little annoyed of late years myself at the indifference which associate members were showing the Association. Ever since I could do anything I have been kept tolerably busy all the the time, and I think there is nothing so healthy as a person being kept busy; and it occurred to me it would not be a very bad plan to take possession of one of those associate members and add him on to one of those committees, and let the chairman of the committee see that he does some work, and if he does not, let him report him to the Association, and let the Association just drop his name from the list. The man who is not willing to work is not deserving to eat, and I think that we can possibly make our reports more valuable by just changing our tactics a little, and I think that is worthy of consideration and of a trial. I am quite sure that if those gentlemen were added on to those committees, and if the chairman of the committees would take proper steps, he could get quite considerable labor out of them, and that it would do this Association a great deal of good.

Mr. Hickey.—While I believe that our associate members have not rendered the Association the information that they could have done—the service they could have done, I do not think the Association ought to go on record as saying that they have been of no service to us whatever. I think those who have looked among our reports in years past will find some valuable papers among those reports prepared by associate members and I would hate to see the convention going on record as saying they were of no service to us.

Secretary Sinclair.—I wish to explain, as the officer responsible for having no papers from an associate members this year, that the list of subjects was so long, there were so many things to be taken up, that I felt sure there would be more business than we could get through with. Consequently I thought I was perfectly justified in omitting a paper from an associate member, but I can assure you that I shall not make the same mistake in the future.

Mr. Whitney.—Then, Mr. Chairman, it was not the fault of the associate members this year that they rendered no service.

The President.—Is the Committee on subjects ready to report?

The report of the Committee on Subjects was read by the Secretary and is as follows:

REPORT OF COMMITTEE ON SUBJECTS FOR DISCUSSION AT NEXT CONVENTION.

Exhaust Pipes and Nozzles. Best forms and sizes of, in proportion to size of cylinders, and any special data regarding new styles.

Driving and Engine Truck Boxes. Best form and material, including journal bearings, and manner of fastening bearing in box.

Boiler Covering. Best method of, and material to prevent radiation of heat.

Driver Brakes. Best manner of applying, including best form and material for driver brake shoes.

Best proportion of grate and flue area.

Electric Head-lights.

Foundation ring for boiler leg. Advisability of double riveting.

Water space surrounding fire-box, and the spaces between flues. Are they sufficient for free circulation with rapid generation of steam?

JOHN PLAYER,
T. W. GENTRY, } Committee.
GEO. HACKNEY,

MR. STEVENS.—I move that the report be accepted and committees appointed.

The motion was carried.

THE PRESIDENT.—The chair will take time to appoint committees.

IN FAVOR OF CONSOLIDATING M. M. AND M. C. B. CONVENTIONS.

MR. STEVENS.—Some of the members have suggested the advisability, instead of the Car Builders meeting one week and the Master Mechanics another, of consolidating the two conventions into one week and dividing the time; and I would move that the committee who have in charge the selection of the place of meeting make that a subject of inquiry; that is, inquire as to the practicability of it. Mr. Forney spoke in particular about that; in fact, he went away reluctantly; he would have liked to stay through this convention, but he had attended the Master Car Builders', and as this convention extended through the following week, he could not leave his business long enough. I find that is the general sentiment of men who have charge of both departments, that the stay is too prolonged. I make that as a motion, that the committee who have in charge the selection of the place of meeting make that the subject of inquiry—the practicability of holding the two conventions in the same week.

THE PRESIDENT.—I would just say for the information of Mr. Stevens that a number of years ago this Association appointed a committee to confer with a similar committee for that very purpose. When the matter came up in the Master Car Builders' convention they very quietly laid it on the table, and said nothing about it.

MR. STEVENS.—That might have been all right several years ago; but you know we change from year to year. We change as an Association and we change physically and mentally and all that.

Secretary Sinclair.—I would like to ask if Mr. Stevens means to make that inquiry with a view of holding the two conventions together next year.

Mr. Stevens.—That was not the intention, unless it could be so done in the judgment of the Executive Committee. I recognize quite well that there are some hornets, of course, that you will stir up, and perhaps it will not be done next year or the following year; but it will come about; that will be the ultimate result. There will be one week devoted to conventions and the time divided between the two conventions.

The motion was carried.

Mr. Johann.—I was just going to suggest that there is no impropriety, if the Supervisory Committee see proper, to devise the arrangement. Why not let them order it for trial at the next meeting? I do not think that the members would object to that, if called upon to meet at a place that is large enough and has accommodations enough for both of us we can just as well both conduct our business in the same week as in any other week. Now, inasmuch as they sat down on us once before on that question, let us have our meeting commence on the third Tuesday in June, and if they see fit to join in, let them join in.

Mr. Mackenzie.—I do not believe there is any chance for us to get a consolidation between the two conventions as long as any of the Master Car Builders are alive. We tried once to get in a superintendent of motive power for president, and that was voted down. I am against any such thing. I do not want to associate with them as a consolidation. I go there as a representative member and that is all I go there for. We have presented good material for their officers and they would not have it. So far as getting through in one week is concerned, I do not believe it could be done. The Master Car Builders did not get through with their convention at all. They simply slurred the matter over. They ought really to take five days to do their work, if they did it as it should be done. I do not believe we ought to do our work in three days. It is a very hard task for a man to sit here five straight hours, three days in succession, and there are a great many that do not leave the Convention during the entire time, and I would be in favor of making if four days and having three and a half to four hours session. We cannot meet in one week; that is all out of the question, I think.

Mr. Stevens.—I move we adjourn.

Mr. Hickey.—May I offer a resolution before we adjourn? Is it in order?

The President.—Only by unanimous consent, if the maker of the motion to adjourn will consent.

Mr. Stevens.—I consent.

VOTE OF THANKS TO NORTHWESTERN RAILROADER.

Mr. Hickey.—There have come here amongst us gentlemen from Minneapolis, the publishers and proprietors of the *Northwestern Railroader*. In coming here they have shown a great deal of enterprise and energy, for they have each morning published the proceedings of our convention of the day previous.

I move that a vote of thanks be tendered to them for their enterprise and industry in coming here and doing this for the benefit of the members of the Association.

The resolution was adopted.

The motion to adjourn was carried.

THE PRESIDENT.—The convention is adjourned until the third Tuesday of June next year.

COMMITTEES FOR CONDUCTING THE BUSINESS OF THE YEAR ENDING JUNE, 1889.

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1. *Purification, or Softening of Feed Water.*

HERBERT HACKNEY,
JOHN PLAYER,
W. T. SMALL.

2. *Tires. Advantage or Otherwise of Using Thick Tires.*

J. W. STOKES,
C. E. SMART,
HENRY SCHLACKS.

3. *Exhaust Pipes and Nozzles. Best Form and Size in Proportion to Cylinder.*

C. F. THOMAS,
A. W. GIBBS,
GEO. D. HARRIS.

4. *Driving and Engine Truck Boxes. Best Form and Material, Including Journal Bearing and Manner of Fastening Same in Box.*

WM. BUCHANAN,
JNO. W. CLOUD,
J. M. BOON.

5. *Boiler Covering. Best Method and Material to Prevent Radiation of Heat.*

G. W. STEVENS,
JOHN MACKENZIE,
T. B. TWOMBLY.

6. *Driver Brakes. Best Manner of Applying, Including Best Form and Material for Driving Brake Shoes.*

CHARLES BLACKWELL,
H. D. GORDON,
W. H. THOMAS.

7. *Best Proportion of Grate and Flue Area.*

J. DAVIS BARNETT,
G. W. ETTENGER,
PHILIP WALLIS.

8. *Foundation Ring for Boiler-Leg. Best Form, and Advisability of Double Riveting.*

J. N. LAUDER,
W. J. ROBERTSON,
HARRY TANDY.

9. *Water Space Surrounding Fire-Box and Flues. Is It Usually Large Enough for Free Circulation?*

JOHN HICKEY,
J. N. BARR,
R. W. BUSHNELL.

10. *Magnetic Influence of Iron and Steel in Locomotives on the Watches of Engine-Runners.*

T. W. GENTRY,
JAMES MEEHAN,
HARVEY MIDDLETON.

***Paper** to be Read by*

COLMAN SELLERS, Associate Member.

***Obituary**—Charles T. Parry.*

E. H. WILLIAMS,
ISAAC DRIPPS,
H. D. GARRETT.

Obituary—W. H. Morrow.

W. L. AUSTIN,
L. M. AMES,
L. B. PAXSON.

Obituary—Robert Curtis.

E. B. WALL,
W. W. REYNOLDS,
LEROY KELLS.

Obituary—J. O. D. Lilly.

REUBEN WELLS,
WM. SWANSTON,
JOHN MCKENNA.

Executive Committee and Trustees of Boston Fund and Printing Fund.

J. H. SETCHEL,
R. H. BRIGGS,
JOHN MACKENZIE,
GEORGE RICHARDS,
ANGUS SINCLAIR.

Committee on Subjects for Investigation and Discussion.

JOHN PLAYER,
T. W. GENTRY,
GEO. HACKNEY.

CONSTITUTION AND BY-LAWS,

AS ESTABLISHED BY THE TWENTY-FIRST ANNUAL CONVENTION.

ARTICLE I.

NAME.

The name of this Association shall be the AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

ARTICLE II.

OBJECTS OF ASSOCIATION.

The objects of this Association shall be the advancement of knowledge concerning the principles, construction, repair and service of the rolling-stock of railroads, by discussions in common, the exchange of information, and investigations and reports of the experience of its members; and to provide an organization through which the members may agree upon such joint action as may be required to give the greatest efficiency to the equipment of railroads which is entrusted to their care.

ARTICLE III.

MEMBERSHIP.

Section 1. The following persons may become active members of the Association, on being recommended by two members in good standing, signing an application for membership and agreement to conform to the requirements of the constitution and by-laws, or authorizing the Secretary to sign the constitution for them.

(1.) Those above the rank of general foreman, having charge of the design, construction or repair of railway rolling-stock.

(2.) General foremen, if their names are presented by their superior officers.

(3.) Two representatives from each locomotive building works.

Sec. 2. Civil and mechanical engineers, or other persons having such a knowledge of science or practical experience in matters pertaining to the construction of rolling-stock as would be of especial value to the Association or railroad companies, may become associate members on being recommended by three active members. The names of such candidates shall then be referred to the executive committee, and on a unanimous report from that committee in favor of their election the names of such candidates shall be submitted to ballot at any regular meeting and five dissenting votes shall reject. The number of associate members shall not exceed twenty, and they shall be entitled to all the privileges of active members, excepting that of voting.

Sec. 3. All members of the Association excepting as hereafter provided, shall be subject to the payment of such annual dues as it may be necessary to assess for the purpose of defraying the expenses of the Association, provided that no assessment shall exceed five dollars a year.

Such dues shall be payable when the amount thereof is announced by the President, at each annual meeting. Any member who shall be two years in arrears for annual dues, shall be notified of the fact, and if the arrears are not paid within three months after such notification, his name shall be taken from the roll and he be duly notified of the same by the Secretary.

Sec. 4. Any person who has been or may be duly qualified as a member of this Association will remain such until his resignation is voluntarily tendered, or he becomes disqualified by the terms of this constitution.

Sec. 5. Members of the Association who have been in good standing for not less than five years and who through age or other cause cease to be actively engaged in the mechanical department of railway service, may, upon the unanimous vote of the members present at an annual meeting, be elected Honorary Members. The dues of Honorary members shall be remitted, and they shall have all the privileges of acting members excepting that of voting.

Sec. 6. Any member who, during the meetings of the Association, shall be guilty of dishonorable conduct which is disgraceful to a railroad officer and a member of the Association, or shall refuse to obey the chairman when called to order, may be expelled by a two-thirds affirmative vote at any regular meeting of the Association held within one year from the date of the offense.

ARTICLE IV.

OFFICERS.

Sec. 1. The officers of the Association shall be a President, a First Vice-President, a Second Vice-President, a Treasurer and a Secretary, and they shall constitute the Executive Committee.

ARTICLE V.

DUTIES OF OFFICERS.

Sec. 1. It shall be the duty of the President to preside at all the meetings of the Association, appoint all committees designating the chairman, and approve all bills against the Association for payment by the treasurer.

Sec. 2. It shall be the duty of the Vice-Presidents, according to rank to perform the duties of the President in his absence from the meetings of the Association.

Sec. 3. In case of the absence of both President and Vice-Presidents, the members present shall elect a President pro tempore.

Sec. 4. It shall be the duty of the Secretary to keep a full and correct record of all transactions at the meetings of the Association ; to keep a record of the names and places of residence of all members, and the name of the railway they each represent ; to receive and keep an account of all money paid to the Association and deliver the same to the treasurer, taking his receipt for the amount ; to receive from the treasurer all paid bills, giving him a receipted statement of the same.

Sec. 5. It shall be the duty of the Treasurer to receive all money from the Secretary belonging to the Association ; to receive all bills and pay the same, after having the approval of the President ; to deliver all paid bills to the Secretary at the close of each meeting, taking a receipted statement of the same and to keep an accurate book account of all transactions pertaining to his office.

ARTICLE VI.

EXECUTIVE COMMITTEE.

Sec. 1. The Executive Committee shall exercise a general supervision over the interests and affairs of the Association, recommend the amount of the annual assessment, to call, to prepare for, and to conduct, general conventions, and to make all necessary purchases, expenditures and contracts required to conduct the current business of the Association, but shall have no power to make the Association liable for any debt to an amount beyond that which at the time of contracting the same shall be in the Treasurer's hands in cash, and not subject to prior liabilities. All expenditures for special purposes shall only be made by appropriations acted upon by the Association at a regular meeting.

BOSTON FUND.

Sec. 2. The Executive Committee shall be a Board of Trustees having the care of the Boston fund. They shall appoint its custodian and give directions as to the investment of both its principal and interest; but they shall have no power to expend any portion of the fund unless authorized by a majority of the members present at an annual meeting and then only after due notice in writing, of a motion to expend such money has been given at the preceding annual meeting. A report of the state of this fund shall be made at each annual meeting, by the Executive Committee.

Sec. 3. The Executive Committee shall receive, examine and approve before public reading, all communications, papers and reports on all mechanical and scientific matters; they shall decide what portion of the reports, papers and drawing shall be submitted to each convention and what portion shall be printed in the Annual Report.

Sec. 4. Three members shall constitute a quorum for the transaction of business.

ARTICLE VII.

ELECTION OF OFFICERS.

Sec. 1. The officers of the Association shall be elected by ballot separately at the regular meeting of the Association, held in

June of each year. A majority of all votes cast shall be necessary to an election and elections shall not be postponed.

Sec. 2. Two tellers shall be appointed by the President to conduct the election and report the result.

ARTICLE VIII.

COMMITTEES.

Sec. 1. At the first session af the annual meeting, the President shall appoint a Nominating Committee of five members, who are not officers of the Association, and this committee shall send the names of nominees for offices of the Association to fill vacancies for the ensuing year to the Secretary before the election of officers is in order, and they shall be announced by him as soon as received. The election shall not be held until the day after such announcement, excepting by unanimous consent. Any three other members may nominate candidates for any office.

AUDITING COMMITTEE.

Sec. 2. At the first session of each annual meeting an Auditing Committee, consisting of three members not officers of the Association, to be nominated by any member who does not hold office shall be elected in the same way as officers are voted for. This Auditing Committee shall examine the accounts and vouchers of the Treasurer and certify whether they have been found correct or not. After the performance of this duty they shall be discharged by the acceptance of their report by the Association.

COMMITTEE ON SUBJECTS FOR INVESTIGATION AND DISCUSSION.

Sec. 3. At each annual meeting the President shall appoint a committee whose duty it shall be to report at the next annual meeting subjects for investigation and discussion, and if the subjects are approved by the Association the President, as hereinafter provided, shall appoint committees to report on them. It shall also be the duty of the committee to receive from members questions for discussion during the time set apart for that purpose. This committee shall determine whether such questions are suitable ones for discussion, and if so, they shall so report them to the Association.

COMMITTEES OF INVESTIGATION.

Sec. 4. When the committee on subjects has reported and the Association approved of subjects for investigation, the President shall appoint special committees to investigate and report on them, and he may authorize and appoint a *special* committee to investigate and report on any subject which a majority of the members present may approve of.

ARTICLE IX.

AMENDMENTS.

Sec. 1. This constitution may be amended at any regular meeting by a two-third vote of the members present, provided that written notice of the proposed amendments has been given at a previous meeting at least six months before.

BY-LAWS.

TIME OF MEETING.

I. The regular meeting of the Association shall be held annually on the third Tuesday in June.

HOURS OF SESSION.

II. The regular hours of session shall be from nine o'clock a. m. to two o'clock p. m.

PLACE OF MEETINGS.

III. " Places for holding the Annual Convention may be proposed at any regular meeting of the Association. Before the final adjournment the places proposed shall be submitted to a vote of the members and within six months thereafter the Executive Committee shall select a place from the three which have received the highest number of votes."

QUORUM.

IV. At any regular meeting of the Association fifteen or more members entitled to vote shall constitute a quorum.

ORDER OF BUSINESS.

V. The business of the meetings of this Association shall, unless otherwise ordered by a vote, proceed in the following order :

1st. Opening Prayer.
2d. Calling the roll.
3d. Acting on the minutes of the last meeting.
4th. Address by the President.
5th. Admission of new members.
6th. Reports of Secretary and Treasurer.
7th. Assessment and announcement of annual dues.
8th. Appointment of Nominating Committee.
9th. Election of Auditing Committee.
10th. Unfinished business.
11th. New business.
12th. Reports of committees.
13th. Reading of papers and discussion of questions propounded by members.
14th. Routine and miscellaneous business.
15th. Election of officers.
16th. Adjournment.

QUESTIONS FOR DISCUSSION, SPECIAL ORDER OF.

VI. Unless otherwise ordered, the discussion of questions proposed by members shall be the special order from 12 o'clock m. to one p. m., of each day of the annual meeting.

DECISIONS.

VII. The votes of a majority of the members shall be required to decide any question, motion or resolution which shall come before the Asssociation unless otherwise provided.

DISCUSSIONS.

VIII. No patentees or their agents shall be admitted in the meetings of the Association for the purpose of advocating the claims of any patent or patentee, unless by unanimous consent.

IX. No member shall speak more than twice in the discussion of any question until all the other members who want to speak and have not been heard have spoken.

NAMES AND ADDRESSES OF MEMBERS.

NAME.	ROAD.	ADDRESS.
Ackley J. D.	I. I. & Iowa	Kankakee, Ill.
Addis, J. W.	Texas & Pacific	Gouldsboro, La.
Aldcorn, Thos.	West Shore	New Durham, N. J.
Ames L. M.	Beech Creek	Jersey Shore, Pa.
Anderson, H.	204 Dearborn St.,	Chicago, Ill.
Anderson, J. H.		Providence, R. I.
Anderson, E. D.		Vicksburg, Miss.
Arp, W. C.	C. St. L. & P.	Logansport, Ind.
Austin, W. L.	Baldwin Loco. Works	Philadelphia, Pa.
Augustus, W.	Keokuk & Western	Centerville, Ia.
Ball, Charles A.	Georgetown & Western	Georgetown, S. C.
Barnes, J. B.	Wabash	Springfield, Ill.
Barnett, J. Davis	Grand Trunk	Stratford, Ont.
Barnett, T. E.	Canadian Pacific	Vancouver, B. C.
Barnes, F. A.		Stevens Point, Wis.
Barton, J. C.		Hartford, Conn.
Bean, John	C. & Canton Ry.	Canton, O.
Beckert, Andrew	B. & Ohio	Baltimore, Md.
Berry, L. D.		Osceola, Iowa.
Bisset, John	W. W. W. C. & A.	Wilmington, N. C.
Black, John	236 McKibben St.,	Lima, Ohio.
Blackall, R. C.	D. & H. Canal Co.	Albany, New York.
Blackwell, Chas.	Central Georgia	Savannah, Georgia.
Boatman, F. P.	Ohio & Mississippi	Vincennes, Ind.
Boon, James M.	West Shore	Frankfort, New York.
Bosworth, B. C.	Atlantic & Pacific	Needles, Cal.
Bradley, S. D.	G. R. & Indiana	Grand Rapids, Mich.
Bradley, W. F.	K. & Ohio	Charleston, W. Va.
Brastow, L. C.	C. & N. Jersey	Ashley, Pa.
Briggs, R. H.	K. C. M. & B.	Memphis, Tenn.
Brook, Geo. B.		Marshall, Tex.
Brook, L. R.	Lima Iron Works	Birmingham, Ala.
Brown, F. R. F.	Canadian Pacific	Montreal, Quebec.
Brownell, F. G.	B. & Lem.	Burlington, Vt.
Bryan, H. S.	C. B. & Northern	La Crosse, Wis.
Burford, H. N.	Texas & Pacific	Marshall, Tex.
Buchanan, Wm.	N. Y. C. & H. R.	New York, N. Y.

Bushnell, R. W.	B C. R. & N.	Cedar Rapids, Iowa.
Campbell, John	Lehigh Valley	Delano, Pa.
Carson, M. T.	G. C. & S. F.	Galveston, Tex.
Casanave, F. D.	Pennsylvania	Ft. Wayne, Ind.
Chapman, N. E.	333 Walnut St.,	Philadelphia, Pa.
Chapman, T. L.		Richmond, Va.
Clark, David	Lehigh Valley	Hazelton, Pa.
Clark, Peter	Grand Trunk	Toronto, Ontario.
Clark, Isaac W.	C. F. & Y. V.	Fayetteville, N. C.
Clifford, J G.	L & Nashville	Mobile, Ala.
Cloud, John W.	N. Y. L. E. & W.	Buffalo, New York.
Collier, M. L.	Western & Atlantic	Atlanta, Ga.
Cooper, H. L.	4412 Wabash Ave.,	Chicago, Ill.
Cooke, Allen	C. & E. Illinois	Danville, Ills.
Cook, John S.	Georgia	Augusta, Ga.
Cory, C. H.	C. H. & D.	Lima, O.
Cromwell, A. J.	Baltimore & Ohio	Baltimore, Md.
Cullen, Jas	N. C. & St. L.	Nashville, Tenn.
Cushing, G. W.		Chicago, Ill.
Dallis, Wilbur C.	Wisconsin Central	Stevens Point, Wis.
Davis, Jas. A.	N. T. & Q.	Deseronto, Ont.
Davis, N. L.	Rutland	Rutland, Vt.
Divine, J. F.	W. & Weldon	Wilmington, N. C.
Dickson, G. L.	Dickson Loco. Works	Scranton, Pa.
Dickson, J. P.	Dickson Loco. Works	Scranton, Pa.
Domville, C. K.	Grand Trunk	Hamilton, Ont.
Dotterer. D. H.	Atlantic & Pacific	Albuquerque, N. M.
Downe, Geo.	Govt.	Sydney, Australia.
Dripps, W. A.	3224 Walnut St.,	Philadelphia, Pa.
Durrell, D. J.	Union Pacific	Cheyenne, Wyo. Ter,
Eastman, A. G.		Sutton, Que.
Eckford, James		Bellevue, Ohio.
Eddy, W. H.	Boston & Albany	Springfield, Mass.
Elliott, Henry		East St. Louis, Ill.
Ellis, Matt.	C. St. P. M. & O.	St. Paul, Minn.
Ennis, W. C.	N. Y. S. & Western	Wortendyke, N. J.
Ettenger, G. W.	N. N. & M. V.	Richmond, Va.
Evans, Edward	C. W. & B.	Chillicothe, Ohio.
Evarts, D. T.	N. Y. Loco. Works	Rome, N. Y.
Fenwick, A.	G. B. W. & St. P.	Green Bay, Wis.
Ferguson, G. A.	Boston & Maine	Lake Village, N. H.
Ferguson, Z. J.	Mobile & Ohio	Jackson, Tenn.
Finley L.	St. L. A. & T.	Tyler, Tex.
Flahaven, W. M.	P. & W.	Allegheny, Pa.

Forsyth, Wm.	C., B. & Q.	Aurora, Ill.
Foss, J. M.	Central Vt.	St. Albans, Vt.
Foster, W. A.	Fall Brook Coal Co.	Corning, N. Y.
Fowle, I. W.	C. N. O. & T. P.	Meridian, Miss.
Frazer, T. A.	M. S. S. M. & A.	Minneapolis, Minn.
Fuller, William		213 Kennard St., Cleveland, Ohio.
Galloway, A.		Cambridge, Ohio.
Garrett, H. D.	Pennsylvania	Philadelphia, Pa.
Garstang, Wm.	Ches. & Ohio	Huntington, W. Va.
Gates, W. G.	Richmond & Danville	Salisbury, N. C.
Gentry, T. W.	Richmond & Danville	Richmond, Va.
George, Nathan M.		Danbury, Conn.
Gibbs, A. W.	Richmond & Danville	Atlanta, Ga.
Gilmour, W. L.	L. S. & M. S.	Elkhart, Ind.
Gordon, H. D.	P. W. & Baltimore	Wilmington, Del.
Gordon, Jas. T.	Concord	Concord, N. H.
Graham, Chas.	D. L. & Western	Scranton, Pa.
Graham, J. S.	L. S. & M. S.	Cleveland, Ohio.
Greenwood, A. W,	East Broad Top	Orbisona, Pa.
Griffith, Fred B.	D. L. & Western	Buffalo, N. Y.
Griggs, Albt.	P. & Worcester	Providence, R. I.
Gugel, Danl. M.	Centl. Ga.	Macon, Ga.
Hackney, Clem.	Union Pacific	Omaha, Neb.
Hackney, Geo.	A. T. & S. F.	Topeka, Kans.
Hackney Herbert	A. T. & S. F.	Topeka, Kans.
Haggett, J. C.	D. & A. Valley	Dunkirk, N. Y.
Haggerty, G. A.	New Brunswick	St. Johns, N. B.
Haines, S. W.		Pittsburgh, Pa.
Hall, Don Diego		Santiago, Chili.
Hall, J. W.	Louisville & Nash.	Montgomery, Ala.
Ham, C. T.		Buffalo Steam Gauge Co., Rochester, N. Y.
Hanson, C. F.	Grand Trunk	London, Ontario.
Harding, B. R.	R. G. R. & A.	Raleigh, N. C.
Harris, Geo. D.	Mobile & Ohio	Jackson, Tenn.
Harrison, W. H.	Baltimore & Ohio	Newark, O.
Hatswell, T. J.	F. & P. M.	East Saginaw, Mich.
Haselton, G. H.	R. W. & O.	Oswego, N. Y.
Hassman, Wm.	R. & Alleghany	Richmond, Va.
Haynes, O. A.	Missouri Pacific	St. Louis, Mo.
Headden John		Roger Loco. Wks., Paterson, N. J.
Hemphill, W. J.	Jacksonville South E.	Jacksonville, Ill.
Hendee, A.		Westinghouse Air Brakes, Pittsburgh, Pa.
Henney, J. B.	N. Y. & N. E.	Boston, Mass.
Henney, John	N. Y. N. H. & H.	New Haven, Conn.

Hentzelman, T. W.		St. Paul, Minn.
Hewett, John		1323 Jefferson, Ave., St. Louis, Mo.
Hickey, John	M. L S. & Western	Kaukauna, Wis.
Hill, Jas. W.	Peoria & Pekin Union	Peoria, Ill.
Hinman, M. L.		Brooks Loco. Wks., Dunkirk. N. Y.
Hobart, C. C.		The Dalles. Oregon.
Hodgman, S. A.		Lobdell Car Co., Wilmington, Del.
Hoffecker, W. L.	Central of New Jersey	Elizabethport, N. J.
Holman, W. L.	Pennsylvania	Renova, Pa.
Horniblow, J. P.	Govt.	Brisbane, Queensland.
Howson, N. W.		Eames Brake Co, Watertown, N. Y.
Jackson, O. H.	O. & Miss.	Vincennes, Ind.
Jaques, Richard		87 Milk St., Boston, Mass.
Jeffery, E. T.	Ill. Cent.	Chicago, Ill.
Johann, Jacob		Springfield, Ill.
Johns, C. T.	Valley	Cleveland, Ohio.
Johnson, J. B.	A. Midland	Helena, Ark.
Johnson, L. R.	Canadian Pacific	Vancouver, B. C.
Johnstone, F. W.	Mexican Central	City of Mexico.
Joughins, G. R.	Erie & Huron	Chatham, Ont.
Keeler, Sanford	F. & P. M.	East Saginaw, Mich.
Kiehner, John I.		2341 E. York St., Philadelphia, Pa.
Kiley, M. R.	St. Jo. & G. I.	St. Joseph, Mo.
Kells, Leroy	P. C. & St. L.	Cincinnati. O.
Kimball, N. S.	M. & Northern	Green Bay, Wis.
Kinsey, J. I.	Lehigh Valley	Easton, Pa,
Kolseth, Henry S.		Westinghouse Air Brake Co., Pittsburgh, Pa.
Lannan, Wm.		House of Representatives, Washington, D. C.
Lape, C. F.	Wabash	Springfield, Ill.
Lape, J. R.	W. St. L. & P.	Moberly, Mo.
Lauder, J. N.	Old Colony	Boston, Mass.
Leach, H. L.		1 Rollins St., Boston, Mass.
Leeds, Pulaski	L. & Nashville	Louisville, Ky.
Lewis, W. H.	D. L. & Western	Kingsland, N. J.
Losey, Jacob		Steam Forge Co., Louisville, Ky.
Lythgoe, Joseph		Rhode Island Loco. Wks., Providence, R. I.
Mackenzie, John	N. Y. C. & St. L.	Cleveland, O,
Manly, Basil	A. & N. C.	Newberne, N. C.
Maver, A. A.	Grand Trunk	Hamilton, Ontario.
McBeth, James	West Shore	Buffalo, N. Y.
McCrum, J. S.	K. C. Ft. S. & G.	Kansas City, Mo.
McFarland, Wm.		725 Edgerton, St., St. Paul, Minn.
McGlenn, James	Carolina Central	Laurenburg, N. C.
McGrayel, John	C R. I. & P.	Grand Junction, Iowa.

McKenna, John	I. D. & S.	Indianapolis, Ind
Medway, John	Fitchburg	Mechanicsville, N. Y.
Meehan, James	C. N. O. & T. P.	Ludlow, Ky.
Michael, J. B.	E. T. V. & Ga.	Knoxville, Tenn.
Middleton, Harvey	L. & Nashville	Louisville, Ky.
Millen, Thomas	N. Y. City & N.	High Bridge, N. Y.
Mills, C. W.	B. Rochester & Pittsburgh	Rochester, N. Y.
Minshull, E.	N. Y. O. & W,	Middletown, N. Y.
Mitchell, A.	Lehigh Valley	Wilkesbarre, Pa.
Montgomery, Wm.	C. of N. J.	Manchester, N. J.
Morrell, J. E.	C. R. I. & P.	Davenport, Ia.
Morris, W. S.	Wabash	Fort Wayne, Ind.
Morse, G. F.	Portland Loco. Works,	Portland, Me.
Mulligan, J.	Conn. River	Springfield, Mass.
Nichols, Edward	Brooks Loco. Works,	Dunkirk, N. Y.
Noble, L. C.	H. & T. C.	Houston, Tex.
Olcott, H. P.	A. T. & S. F.	Coolidge, Kans.
Ortton, John		Albany, N. Y.
Patterson, J. S.	C. I. St. L. & C.	Cincinnati, O.
Paxon, L. B.	Phil. & Reading	Reading, Pa.
Peck, Peter H.	C. & W. I. & Belt	Chicago, Ill.
Perry, F. A.	Cheshire	Keene, N. H.
Petrie, Ira	J. & S E.	Jacksonville Fla.
Pitkin, A. J.	Schenectady Loco. Works,	Schenectady, N. Y.
Place T. W.	Illinois Central	Waterloo, Iowa.
Player, John	Wisconsin Central	Waukesha, Wis.
Porter, Joseph S.	C. S. & C.	Sandusky, O.
Prescott, G. W.	25 S. Fourth St.,	St. Louis, Mo.
Prescott, G. H.	T. H. I. & St. L.	Terre Haute, Ind.
Pilsbury, Amos	Maine Central	Waterville Me.
Pringle, R. M.	1101 N. Second Street,	St. Louis, Mo.
Purvis, T. B.	Boston & Albany	East Albany, N. Y.
Quackenbush, A. W.	Wabash & Western	Moberly, Mo.
Quayle, Robert	C. & Northwestern	Clinton, Ia.
Quinn, J. A.	C. V. & C.	Mt. Carmel. Ill.
Reed, W. T.	Chi. St. Paul & Kas. C.	St. Paul, Minn.
Rennel, Thomas	M. & Little Rock	Argenta, Ark.
Renshaw, W.	Illinois Central	Chicago, Ill.
Reynolds, W. W.	C. St. L. & P.	Columbus, O.
Rhodes, G. W.	C. B. & Q.	Aurora, Ill.
Richards, Geo.	14 Auburn St.,	Roxbury, Mass.
Richards, Jackson	908 Green St ,	Philadelphia, Pa.
Richardson, E.	S. & Allegheny	Greenville, Pa.
Richardson, R. M.	Missouri Pacific	Little Rock, Ark.

Robb, W. D.	L. & Nashville	Pensacola, Fla.
Roberts, E. M.	A. C. & I. Co.	Ashland, Ky.
Robertson, W. J.	C. Vermont	St. Albans, Vt.
Ross, Geo. B.	293 S. Div. Street,	Buffalo, N. Y.
Rossiter, C. W.	19 Glen Ave.,	Duluth, Minn.
Sample, N. W.	D. & R. G.	Denver, Col.
Sanborn, C. A.		Carondelet, Mo.
Sanborn, J. M.	L. S. & M. S.	Norwalk, O.
Schaeffer, Aug.	Maysville Water Works,	Maysville, Ky.
Schlacks, Henry	Illinois Central	Chicago, Ill.
Sedgwick, E. B.	D. S. S. & A.	Marquette, Mich.
Selby, W. H.	C. & Atlantic	Huntington, Ind.
Sellers, Morris	6 Ashland Block,	Chicago, Ill.
Setchel, J. H.		Dunkirk, N. Y.
Shaver, D. O.	Pennsylvania	Pittsburgh, Pa.
Sheppard, F. L.	Pennsylvania	Altoona, Pa.
Short, W. A.	O. & L. C.	Malone, N. Y.
Sitton, B. J.	Shenandoah Valley	Milnes, Va.
Small, W. T.	Northern Pacific	St. Paul, Minn.
Smart, C. E.	Michigan Central	Jackson, Mich.
Smith, Allison D.	Govt.	New Port, Victoria.
Smith, F. C.	P. D. & E.	Mattoon, Ill.
Smith, Howard M.	Richmond & Danville	Alexandria, Va.
Smith, Wm.	Boston & Maine	Boston, Mass.
Smith, W. F.		Sacramento, Cal.
Smith, W. T.		Huntington, W. Va.
Sprague, H. N.	Porter Loco. Works,	Pittsburgh, Pa.
Stapf, F. M.		Mt. Carmell, Ill.
Stearns, W. H.	Conn. River	Springfield, Mass.
Stephens, S. A.	Rhode Island Loco. Wks.,	Providence, R. I
Stevens, Geo. W.	L. S. & M. S	Cleveland, O.
Stewart, O.	Fitchburg	Charlestown, Mass.
Stinard, F. A.	N. Y. L. E. & W.	Jersey City, N. J.
Stokes, J. W.	Ohio & Mississippi	Pana, Ill.
Stone, W. A.	L. E. & St. L.	Huntingburg, Ind.
Strode, James	N. Central	Elmira, N. Y.
Sullivan, A. W.	Illinois Central	Cairo, Ill.
Swanston, Wm.	C. St. L. & P.	Indianapolis, Ind.
Tandy, H.	N. Y. O. & W.	Middletown, N. Y.
Taylor J. K.		Concord, N. H.
Teal, S. A.	F. E. & M V.	Missouri Valley, Ia.
Thacher, Thomas	D. L. & W	Utica, N. Y.
Thomas, C. F.	E. T. V. & Georgia	Atlanta, Ga.
Thomas, W. H.	E. T. Va. & Georgia	Knoxville, Tenn.

Thompson, John		Boston, Mass.
Thompson, W. A.	M. H. & O.	Marquette, Mich.
Thow, Wm.	So. Australia	Adelaide, Australia.
Tinker, S. B.	C. W. & Michigan	Wabash, Ind.
Torrence, John	E. & T. H.	Evansville, Ind.
Tregelles, Henry	N. Y. L. E. & W.	Elmira, N. Y.
Tumser, John		Seymour, Ind.
Turner, J. S.	Eames Vacuum Brake Co.	New York.
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Twombly, A. W.	Old Colony	Taunton, Mass.
Twombly, Fred. M.	Old Colony	Boston, Mass.
Twombly, T. B.	C. R. I. & P.	Chicago, Ill.
Tynan, F. F.	Bay of Havana	Matanzas, Cuba.
Ulmo, H. A.	C. & Savannah	Savannah, Ga.
Underhill, A. B.	B. & Albany	Springfield, Mass.
Van Vechtan, J.	N. Y. L. E. & W.	Port Jervis, N. J.
Wakefield, S. W.	C. R. I. & P.	Keokuk, Iowa.
Walker, C. W.	S. & Roanoke	Portsmouth, Va.
Wall, E. B.	P. C. & St. L	Columbus, O.
Wallis, Herbert	Grand Trunk	Montreal, Can.
Wallis, Phillip	C. B. & Q.	Beardstown, Ill.
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Weisgerber, E. L.	B. & Ohio	Newark, O.
Wells, Reuben	Rogers Loco. Wks.,	Paterson, N. J.
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White, C. M.		Birmingham, Ala.
White, J. F.		Water Valley, Miss.
Whitlock, Joseph	N. H. & D.	Ansonia, Conn.
Whitney, H. A.	Intercolonial	Moncton, N. B.
Wiggins, J. E.		Marshall, Tex.
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Wilder, F. M.		Binghampton, N. Y.
Willard, Daniel		757, 18½ Av., N. E., Minneapolis, Minn.

Williams, C. G.	C. of N. J.	Communipaw, N. J.
Williams, R.		N. Y. Loco. Wks., Rome, N. Y.
Winslow, J. M.		Calle de Ortega, No. 28, City of Mexico.
Wilson, G. F.	M. & St. L.	Minneapolis, Minn.
Wilson, Wm.	C. A. & St. L.	Bloomington, Ill.
Worcester, F. E.	D. S. S. & A.	Marquette, Mich.

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Coleman, John A.	Providence, R. I.
Dean, F. W.	E. Taunton, Mass.
Forney, M. N.	45 Broadway, New York.
Gordon, Alex.	Niles Tool Works, Hamilton, O.
Hill, John W.	Cincinnati, O.
Lyne, L. F.	307 Grove St., Jersey City, N. J.
Miles, F. B.	Philadelphia, Pa.
Sellers, Coleman	Philadelphia, Pa.
Shaw, Thomas	915 Ridge St., Philadelphia, Pa.
Sinclair, Angus	Morse Building, New York.
Smith, W. A.	185 Dearborn St., Chicago, Ill.
Wheelock, Jerome	Worcester, Mass.

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Collidge, G. A.		Charlestown, Mass.
Cummings, S. M.		Dorchester, Mass.
Dripps, Isaac		345 Walnut St., Philadelphia, Pa.
Eddy, Wilson		Springfield, Mass.
Peddle, C. R.		Terre Haute, Ind.
Perrin, P. J.		Taunton Loco. Wks., Taunton, N. J.
Philbrick, J. W.		Waterville, Me.
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Williams, E. H.		Baldwin Loco. Wks., Philadelphia, Pa

OBITUARY.

CHARLES T. PARRY.

Charles T. Parry, one of the senior proprietors of the Baldwin Locomotive Works, died at Beach Haven, N. J., on July 18th 1887, in the sixty-sixth year of his age. He had been a severe sufferer since the November previous from an abscess in the region of the spine, and his death resulted from this cause.

Mr. Parry was born in Philadelphia in September, 1821. In 1836 he began an apprenticeship in the pattern shops of what is now the Baldwin Locomotive Works. After finishing his "time," he worked in the shop for some years as a journeyman, and then was employed in the drawing room. In 1854 or 1855 he was appointed Superintendent of the works. Up to that time locomotive building had not been reduced to a system. Each engine was constructed without much reference to those which were built before or those which would come after it. Complete drawings were almost unknown, and the duplication of parts did not seem to be as important as experience afterwards proved it to be. As the work was done by what may be called a "rule of thumb" method, a good deal of it had to be thrown away because it "didn't come right." The tradition is that when Mr. Parry took charge of the works there was a great accumulation of parts of engines, which, owing to organic malformation, cumbered the shop, filled the spaces under the benches, and, as one member of the present firm expressed it, made it impossible to walk through the place at night without a light. The first duty which Mr. Parry undertook was to clear out this accumulated and useless material. He then took steps to have locomotives built alike, unless there were good reasons for deviating from the established designs and patterns. This was the beginning of the present method of doing work in this shop, which afterwards was developed by Mr. Parry into the elaborate system of standard gauges which has done so much to establish the reputation of the Baldwin Locomotive Works the world over.

The first locomotive which Mr. Baldwin built was the "Old Ironsides," began in 1831 and completed in 1832. It was modeled after a Stephenson engine which was sent over from England for the Newcastle & Frenchtown Railroad, and in the erection of which Mr. Baldwin assisted. Mr. Baldwin's second locomotive, however, was made with a single pair of driving wheels and a four-wheeled truck in front. This type was maintained for some years, until in 1842 he patented his six coupled locomotive with the four front wheels combined in a flexible beam truck. Eight-coupled engines on the same plan eventually superseded the six-wheeled machines. In 1843, locomotives with four driving wheels and a four-wheeled front truck were added to Mr. Baldwin's practice.

The six and eight wheels coupled engines proved to be extremely powerful and efficient freight locomotives, and it was natural that Mr. Baldwin should be slow to adopt new designs. About 1857 or 1858, Mr. Wm. Mason, of Taunton, built a locomotive for the North Pennsylvania Railroad. It was constructed from the designs which Mr. Mason had made a few years earlier. Mr. Parry saw this engine, and was at once impressed with the simplicity of its construction and its graceful form, and recognized that it was the coming type for American locomotives; and as the forms and parts were, as far as possible, laid down in straight lines, it made them easy to fit, and more susceptible of being reduced to standards than the old patterns were. He was then led to revise the old designs which were in vogue in the Baldwin works. The truck wheels were spread far enough apart to permit the cylinders to be brought down into a horizontal position. Both sides of the frames were made with plane surfaces, so that they could be planed from one end to the other. The front ends of the frames were made of single bars, bolted to the back end, and the guide yoke was extended across from one side of the engine to the other. All the details of the locomotive were redesigned, and the Baldwin locomotive of that day was brought abreast of the most advanced practice of the times. Mr. Parry at the same time devoted himself to improving the methods of doing work in the shops. His firm was one of the first, if not the first large establishment, which adopted the Franklin Institute or Sellers system of screw threads. All work as far as possible was made to gauges, so as to be interchangeable. He designed many special tools and machines for doing work. Among them were upright milling machines, planers for planing both ends of connecting rods at once, and a machine for boring brasses in the straps.

The perfection of the system now in use in the Baldwin locomotive works was due to Mr. Parry more than to any other person. He was an excellent judge of men, and remarkable as an organizer, and took great pride in conducting the great establishment, of which he was the mechanical head, in such a way as to produce the greatest results with the means at his disposal. He took great pride in having work well done, and would often remark in the shop, "We will do the work right, and if they don't get price enough in the office it will be their fault." He knew the great difficulty there is in maintaining standards of dimensions and workmanship. He organized a system of piece-work, and to maintain the quality of it would often preserve specimens to be referred to thereafter, and thus keep the men up to the required standard. He recognized not only the need of a system of standards, but also the necessity and difficulty of maintaining it.

He was very considerate to young men, and while he sometimes said that the recognition of merit often did more harm than good, yet he seldom took credit to himself, and seemed to feel that his own position was assured, and therefore there was no need for it; whereas those under him might be encouraged and benefitted if what they did was recognized.

He had traveled in Europe quite extensively, and wherever he went was always a very close observer. While his early education was limited, his natural capacity enabled him to do his own thinking, and he did it well. He had a habit of approaching a subject very cautiously and then, as it were, mentally walking around it so as to get a clear impression from all points of view. Having done this he would treat it with the utmost boldness, and thus reach very decisive conclusions. Among his partners he was familiarly known as the "Philosopher." All inventors and "cranks" of varying degrees of eccentricity, and all letters from them soliciting opinions about their inventions and ideas, were referred to Mr. Parry. Often the absurdity of their inquiries would dispose his associates to treat those who made them with what might be called a lack of deference. Mr. Parry, on the contrary, would always say "Put yourself in his place—he may not have much good sense, but probably that is not his fault." He would then take great pains to explain the merit or demerit—usually the latter—of the inventions or "ideas" submitted for his consideration. Most of the intricate or knotty questions which came to the firm for consideration were submitted to him. Mr. Parry had no ambition to be an inventor. Perhaps his thorough understanding of most mechanical processes naturally prevented him from coming out with crude and unbalanced devices. He would make, however, an adequate and careful study of all the elements involved in any mechanical process, and in innumerable instances would design a method to accomplish the result in a better manner or with greater economy. His time was devoted exclusively to conducting the mechanical or constructing department of the works, and he seldom took part in the commercial matters pertaining to the business.

His sense of humor was a marked trait, and he always enjoyed a joke or a good story as much as any one. He was given to seeing the comical side of things, if there was such a side to see. In illustration of this, the following letter of Mr. Parry to his long-time friend, Mr. H. G. Brooks, will be appreciated by the many who were acquainted with both of the genial parties to the correspondence. It may be said, in explanation, that Mr. Brooks had just left the position of superintendent of motive power of the Erie Railway Company, and was about going into business as a locomotive builder. Hence it was natural that he should be seeking information which he could utilize in his competitive venture.

DUNKIRK, N. Y., Nov. 20th, 1869.

CHAS. T. PARRY, ESQ., Supt. Baldwin Locomotive Works.

Dear Sir: I have at last, after twenty-three years of railway service, severed my connection therefrom, and launched out upon the broad and tempestuous sea of manufacturing. I have, however, lost none of my impudence, for I shall continue to prey upon good nature with the same audacity as of yore.

Brass, you know, is the only combination of metals which in a statue could do my memory full justice.

I am at present engaged in the manufacture of broad gauge stock exclusively, but as I wish to be in readiness to go into narrow gauge work, I shall go on the principle that those who have been years in the business have discovered many good things, which it will be my duty to appropriate in order to show my appreciation of their talent. Some of my friends will suffer in the way of importunities for information, so here goes for your first. What are the requirements from narrow gauge roads in regard to specific dimensions of such details as driving wheel centers, cylinder centers, distance between hubs of driving and truck wheels, sizes and lengths of wheel fits and journals, diameter of wheel centers, frame centers, etc., etc., etc.

Do you use a uniform system of dimensions for such details, or have the roads awakened to a sense of the importance of uniformity in such matters, so that each conform to their standard? What is the cheapest and best cylinder fastening you have yet found? Will you please send me a tracing of it? While I am fully sensible of the impudence of my interrogations, yet I assure you I shall appreciate any information you feel disposed to impart, and shall feel under deep obligations for your kindness, besides being only too happy to reciprocate in any way that lies in my power.

With kind regards to all friends, I am very truly yours,

H. G. BROOKS.

PHILADELPHIA, PA., Nov. 22d, 1869.

H. G. BROOKS, ESQ., Brooks Locomotive Works, Dunkirk, N. Y.

Dear Sir: Your favor of the 20th inst. is at hand. You address me as superintendent of our works. I suppose Dunkirk must be somewhat of a remote place, similar to our Berks county, where the news of the day comes in slowly; where the man who instructs the unterrified how to vote, failing to inform them of the death of General Jackson, they continue to vote for "Old Hickory" to this day.

My demise as superintendent took place about three years ago, and by resurrection I passed into that troublesome state of existence, a proprietor, and I supposed the news had reached

Dunkirk by this time. I am glad you have entered the "sea," for company lightens one's load in affliction, and, as it has been remarked, "a fellow feeling makes us wondrous kind." You speak of it as a "tempestuous sea." I had hardly supposed your short experience would have revealed so much truth in so short a time. But I shall not doubt your sincerity, after you have shoaled on the reefs of hard times and have rode out the monetary gales which shiver our timbers so frequently in these treacherous waters. I sincerely hope you may have fair weather and a prosperous voyage.

You ask me what are the requirements of the narrow gauge (4 ft. 8½ in.) stock? This question startled me somewhat at first, but upon reflection I saw at once that men who are used to wide gauge and wide cars must have expanded minds and widespread ideas, and having been so long out of the canon (I've been to California) that it would be difficult for them to conceive of anything less than a wide spread of prairie, while we, who have passed a lifetime in the narrow limits of 4 ft. 8½ in., are used to being cramped, and can appreciate your difficulty of contraction of ideas to the requirements of the narrow gauge.

Now for the requirements, as compiled from extracts from our letter books, under the head of orders from railroads:

1st. From a Southern road with large ideas and small means. Boiler, 50 in. in diameter; flues, about 250 in number, 2½ in. in diameter; plenty of steam room and free circulation. Cylinders in proportion. The engine in no event to exceed 20 tons in weight. Note—our superstructure light, strap rail.

2d. Western road with wide ideas. Furnace 5 feet wide. Frames not less than 4½ in. wide; plenty of room for springs. Wheels to have tires 6 in. wide; flanges not less than 1½ in. thick. Engine for 4 ft. 8 in. track, with 1½ in. play. Note—wood bad, prairie winds hard on steam.

3d. A coal road with heavy ideas. Eight-wheel engine, weight not less than 70,000 lbs. Driving wheels front and back of fire-box, not over 6½ feet spread; center bearing truck, four-fifths of the whole weight on the drivers. Note—we like plenty of adhesion; grades heavy.

4th. An Eastern road with much experience. We require our smoke-box made square, and fitted to cylinders with round flanges, bolted together underneath with separate saddles.

You see I have given you the requirements as far as relate to boiler, flues, frames, trucks, wheels, play in track, the method of fastening cylinders, and I trust that from your long experience as a railroad engineer, having had charge of fifty different roads, you will be able to suggest the means of meeting the requirements to make the Southern engine weigh not more than 20 tons, to get the Western engine into a 4 ft. 8½ in. track, to get four-fifths of the weight of the coal engine on the driving wheels, and to fasten the cylinders of the Eastern engine.

If you can accomplish all this your success will be certain. As for ourselves, we have failed utterly, and have acknowledged the corn long ago.

I shall be pleased to give you any other information required.

Yours respectfully,
(Signed) CHAS. T. PARRY.

Mr. Parry's character had also a very serious vein. Although in his latter years he did not attend any church regularly, yet he probably thought more of the future than many who apparently give more attention to religious matters than he did. He was an owner of real estate at Beach Haven, where he died, and the Episcopal Church at that place was his personal gift to the Diocese of New Jersey. He was strongly attracted to the doctrines of Swedenborg, and often attended the church of the Rev. Chauncey Giles, of Philadelphia.

During the last fifteen years of his life Mr. Parry had taken a great interest in Beach Haven, N. J. Among the earliest to build a cottage there and invest in lots, he had year after year found increased pleasure and recreation in his summer sojourn and occupation at Beach Haven. A considerable number of attractive cottages, much of the improvements in the roads and walks, a narrow-gauge steam railway connecting the steamboat landing with the hotels, and the handsome Hotel Baldwin with a capacity for nearly 400 guests, are enduring reminders to-day of the keen interest which Mr. Parry so long felt in his favorite sea-shore resort.

A widow, one son and two daughters survive him. His children are all married. The prosperity of the firm of which he was a member, and his own good judgment in the management of his affairs, resulted in the accumulation of a large estate.

His life in a certain sense was uneventful. During his whole business career of 51 years, he was connected in some way with the establishment in which he served his apprenticeship. This is so unusual in this country as to be worthy of remark. The traits of character which could make such a career possible all must admire, and few could leave a more enviable reputation than Mr. Parry did, if at the close of their lives, they are respected and loved as he was by those associated with him in business, some of them for over half a century.

EDWARD H. WILLIAMS,
ISAAC TRIPPS,
HUGH T. GARRETT,
Committee.

ROBERT CURTIS.

Mr. Robert Curtis, Master Mechanic of the Panhandle Railway at Columbus, Ohio, died December 3d 1887. Mr. Curtis was one of the best known railroad men in that part of the state, and was thoroughly known in the city for the interest he had taken in local politics, and the affairs of the city generally. He was born in Syracuse, New York, on the 16th day of September 1835. Mr. Curtis first entered the shops of the Erie Railroad at Buffalo, New York, as an apprentice but finished his trade at the Menominee Locomotive Works, Milwaukee, Wisconsin. Later he was employed at the Milwaukee and St. Paul Shops, where he remained two years, when he was called to take charge as superintendent of the Bay State Iron Works of Milwaukee. He remained with this firm until June 1860, leaving there at that time to accept the position of general foreman of the Panhandle shops at Columbus, Ohio, which position he held but a short time, being promoted to the position of Master Mechanic, which he held at the time of his death. In the death of Mr. Curtis the Railroad Company lost an efficient and faithful officer and the Association a valuable and respected member.

E. B. Wall,
Leroy Kells, } Committee.
W. W. Reynolds,

J. O. D. LILLY.

Mr. J. O. D. Lilly, who was the oldest associate member in the Association, died in March last from injuries received on the Central Railroad of New Jersey, by being struck by a locomotive. Mr. Lilly's first official railroad life was on the Philadelphia and Reading Railroad where he was foreman of the Reading shops from 1847 to 1849. From there he went to Madison, Ind., and became master mechanic of the Madison and Indianapolis Railroad. He held that position for six or seven years and then removed to Lafayette, Ind., to take charge of the Lafayette and Indianapolis Railroad as superintendent. Here he remained till 1862 when he was appointed master machinist of the United States military railways with the title of Colonel and headquarters at Washington. While he was on the Madison and Indianapolis Railroad which is now part of the Pennsylvania system, Mr. Lilly designed a ten wheel engine which was claimed to have been the first of that type ever made a practical success. The engine worked for twenty-eight years and was only recently broken up.

After the finish of the war Mr. Lilly engaged in the varnish business and built up a good trade. He always however took a warm interest in the mechanical work of railroads, and joined the American Railway Master Mechanics' Association as an associate in 1872.

REUBEN WELLS,
WM. SWANSTON, } Committee.
JOHN MC. KENNA,

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